CIVIL ENGINEERING

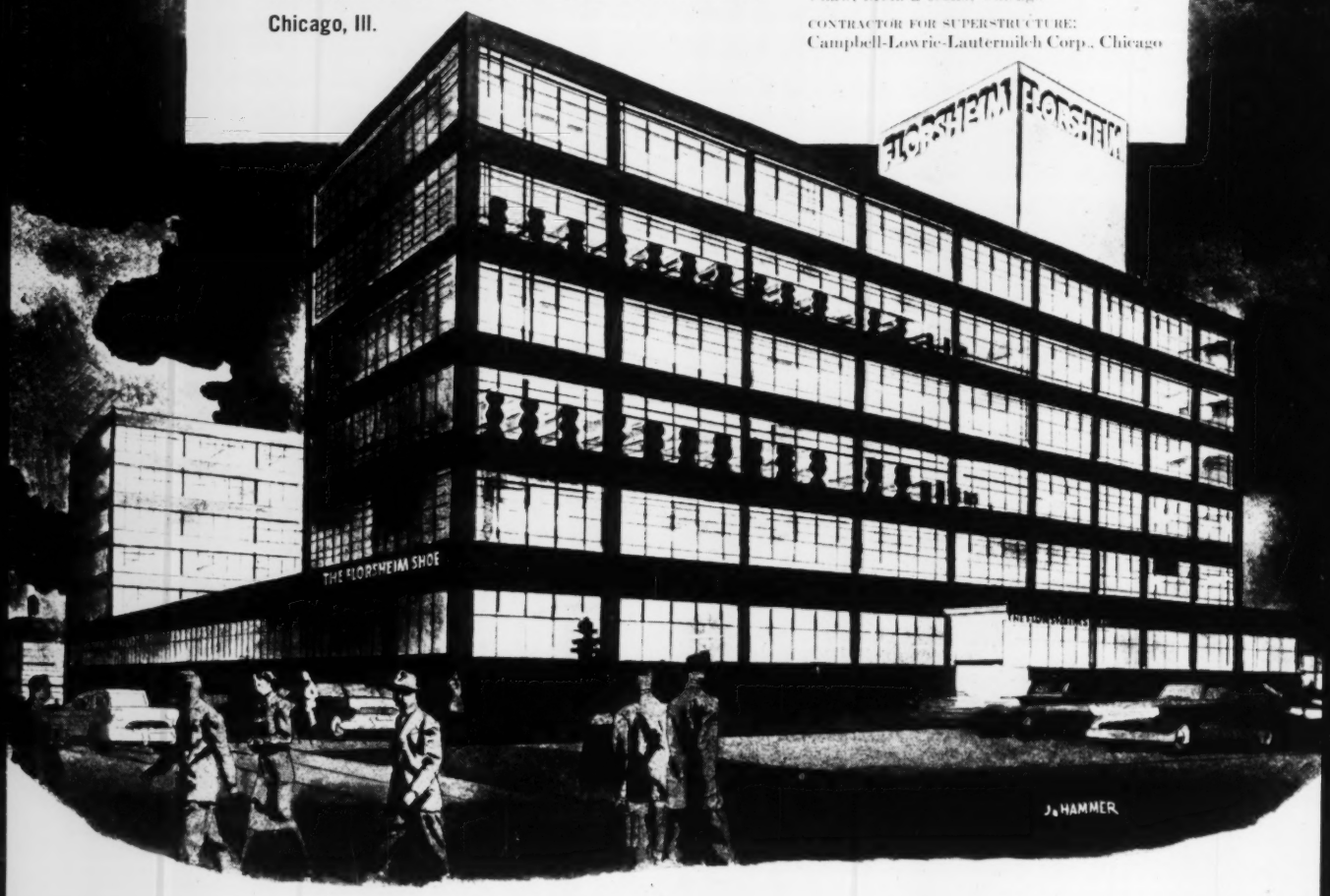
IRON-ORE HANDLING EQUIPMENT
FOR CERRO BOLIVAR PROJECT
VENEZUELA

...the finest structures rest on RAYMOND FOUNDATIONS

FACTORY OF FLORSHEIM SHOE CORPORATION
Chicago, Ill.

ARCHITECTS & ENGINEERS:
Shaw, Metz & Dolio, Chicago

CONTRACTOR FOR SUPERSTRUCTURE:
Campbell-Lowrie-Lautermilch Corp., Chicago



RAYMOND'S DOMESTIC SERVICES . . .
Soil Investigations • Foundation Construction • Harbor and Waterfront Improvements Prestressed Concrete Construction • Cement-mortar Lining of Water, Oil and Gas Pipelines, In Place.

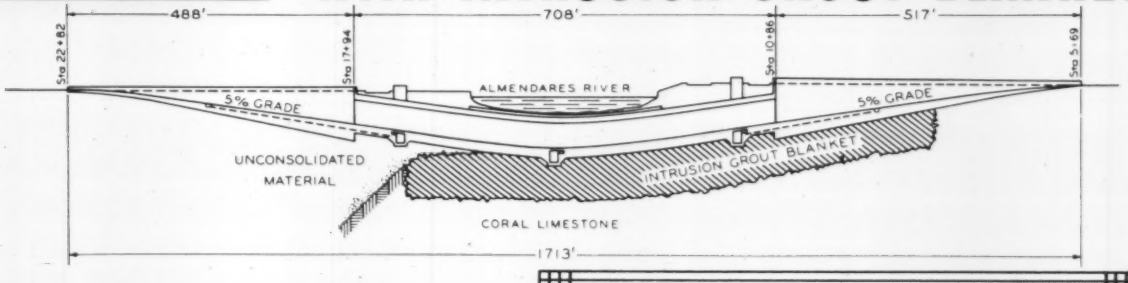
RAYMOND'S SERVICES ABROAD . . .
In addition to the above, all types of General Construction.

RAYMOND
CONCRETE PILE CO.
140 Cedar Street • New York 6, N. Y.

Branch Offices in Principal Cities of the United States, Central and South America

Highly permeable coral limestone under new Havana tunnel presented costly problem of water control for open cofferdam — so...

PREPAKT SEALS POROUS FOUNDATION WITH INTRUSION GROUT BLANKET



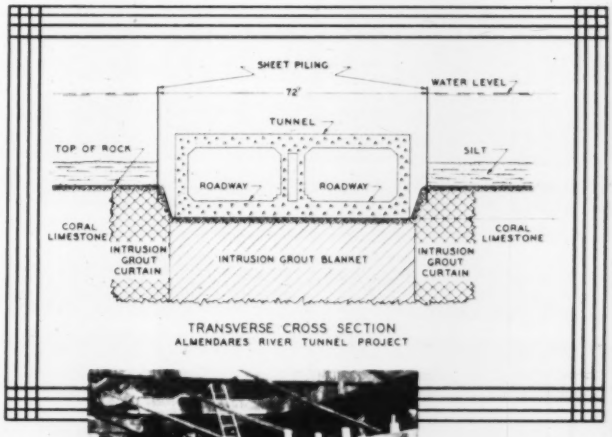
Prepakt's engineering and versatile materials produced a simplified, low-cost solution for water control during construction of the Almendares Vehicular Tunnel, Havana, Cuba. Normal pumping of the open cofferdam in this case would have been difficult and of prohibitive cost.

The porous coral limestone foundation for this twin-barrel, reinforced concrete tunnel was solidified by pumping with INTRUSION grout. This treatment resulted in a horizontal grout blanket 20 to 25 feet thick which effectively sealed the bedrock against water inflow. Some 166,000 sacks of INTRUSION cementing materials were pumped into an estimated 67,000 cubic yards of coral limestone.

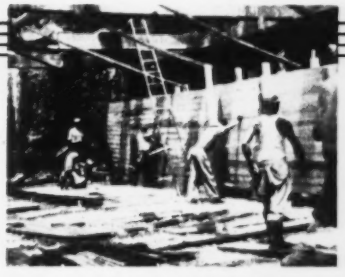
The sheet pile cofferdam was then driven and after dewatering excavation was completed in open cut to 38 feet below river surface with no more than minor seepage. Excavation and subsequent operations were not hampered by water or pumping lines and equipment.

The extra strength and high penetrability of INTRUSION grout made this Intrusion-Prepakt project highly successful —saving time, trouble and money.

Drilling and grouting were performed under subcontract to Raymond Concrete Pile Co.



TRANSVERSE CROSS SECTION
ALMENDARES RIVER TUNNEL PROJECT



Foundation grade, 38 feet below river surface, stays dry after Intrusion grouting.

This Intrusion grouting technique is applicable to many foundation problems. For detailed information, contact the Main Office, Room 779-H, Union Commerce Bldg., Cleveland.

CHICAGO • ATLANTA • BOSTON • DENVER
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CONTRACTORS PREPAKT ENGINEERS

INTRUSION-PREPAKT, INC.
THE PREPAKT CONCRETE CO.

MAIN OFFICE: CLEVELAND 14, OHIO
CANADIAN OFFICE: TORONTO, ONTARIO

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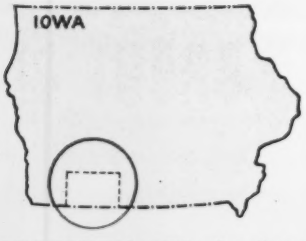
Taking Iowa



RINGGOLD COUNTY has 935 miles of county roads. This is the location of farm to market road construction done by the International Crawler fleet of Easter & Schroeder, Inc.

"IDEAL FOR FARM-TO-MARKET ROAD CONSTRUCTION," say Joe Easter and Don Schroeder (above). "In our eight month's working season, our five TD-18A units, with the sixth as a pusher, moved approximately 540,000 cubic yards, with minimum downtime."

ROAD BUILDING PRODUCTION LINE! Part of the Easter & Schroeder fleet of International crawlers on a regrading job in Ringgold County, Iowa. On this seven-mile stretch they moved 78,000 cubic yards in three weeks' time. *"We move it that way all the time,"* say the owners.

to Town

Farm-to-market roads get big boost fast from the International Crawler fleet of Easter & Schroeder, Inc.

The dirt flies when Easter & Schroeder, Inc., move in with their fast, powerful fleet of International crawlers . . . and Iowans can get to town and back in time to do the milking. For these Griswold, Iowa, contractors specialize in farm-to-market roads in the tall corn state.

Take the seven-mile job in Ringgold County, Iowa, you see here. In three weeks' time, Easter and Schroeder moved 78,000 cubic yards of dirt to give the road a 24-foot top on a 66-foot right of way.

Easter and Schroeder came to this Ringgold County job from one in Taylor County, where they moved 35,000 cubic yards of dirt on a two-mile stretch, completing the job in six 11-hour days.

"After 25-years' experience working in dirt, we settled on a crawler fleet one hundred per cent International," say these contractor partners. The fleet now consists of six International TD-18As with scrapers and 'dozers and a TD-14A with tamping roller.

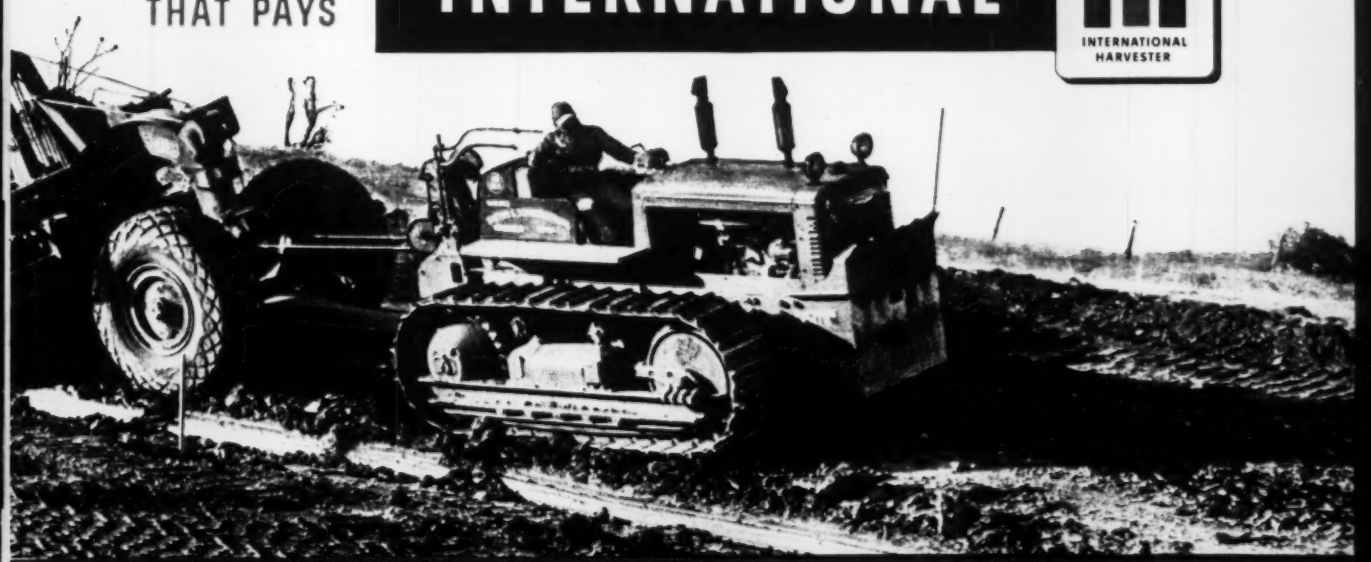
Do you want speed and dependable economy under tough conditions? Then get in touch with your International Industrial Distributor, for all the facts on Power that Pays!

INTERNATIONAL HARVESTER COMPANY, CHICAGO 1, ILL.

POWER THAT PAYS

INTERNATIONAL

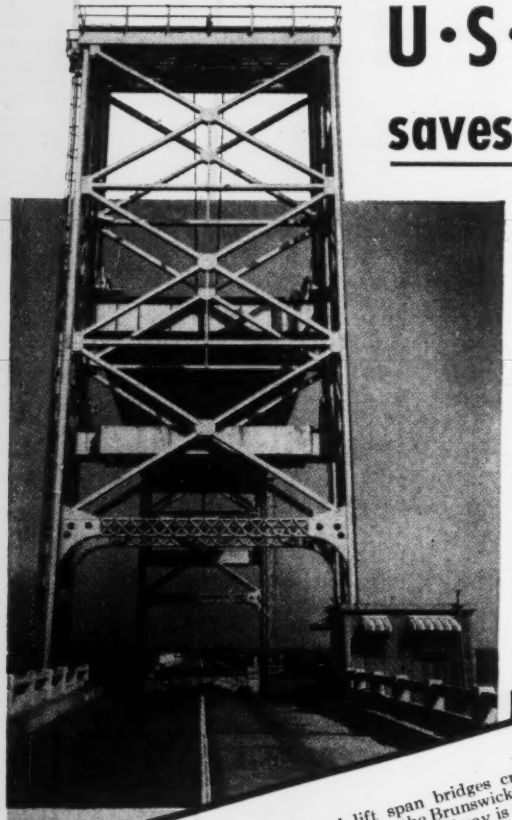
INTERNATIONAL HARVESTER



SEVEN GREAT INTERNATIONAL CRAWLERS . . . EACH WITH MATCHED EQUIPMENT FOR EVERY JOB

On these

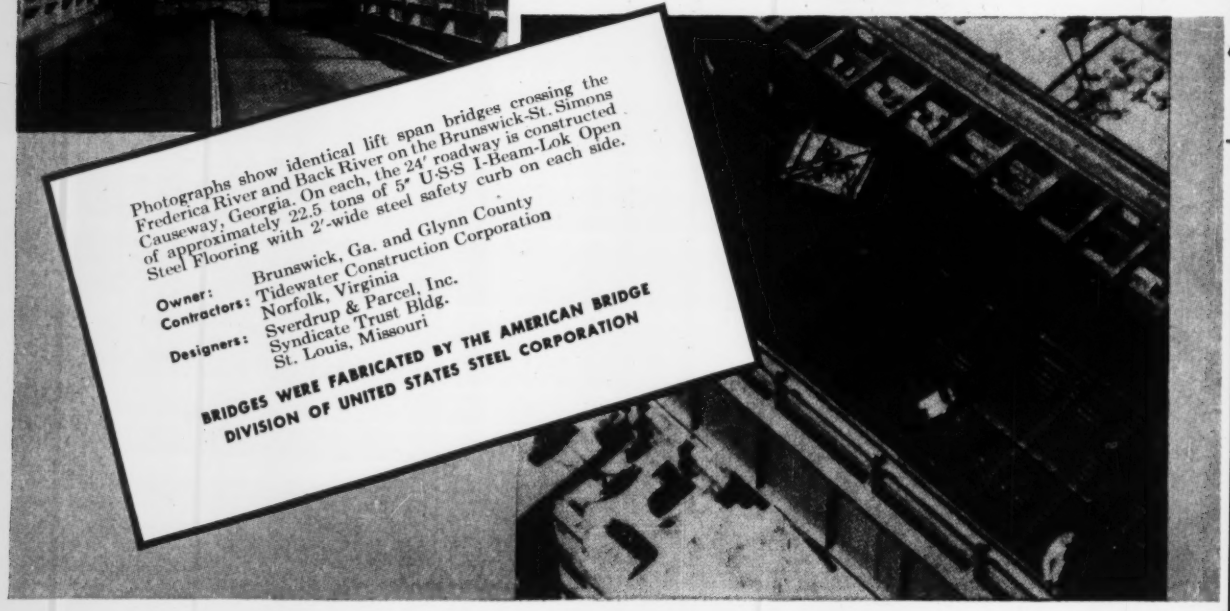
U·S·S I-BEAM-LOK saves approximately 101,000 lbs.



The Frederica River Bridge and the Back River Bridge shown here are part of the Brunswick-St. Simons Causeway in Georgia. They are identical structures. Their lift spans are plate girders with a clear opening for navigation of 100 feet horizontally and 80 feet vertically in the raised position.

These two bridges provide interesting examples of the use of U·S·S I-Beam-Lok Open Steel Flooring to assure substantial economies by saving weight in the flooring.

By using 5″ open steel flooring, which weighs 18.8 psf. as against about 60 psf. for a conventional $6\frac{1}{2}$″ lightweight concrete slab, it was possible to save more than 50 tons in the weight of the floor on each of the bridges.

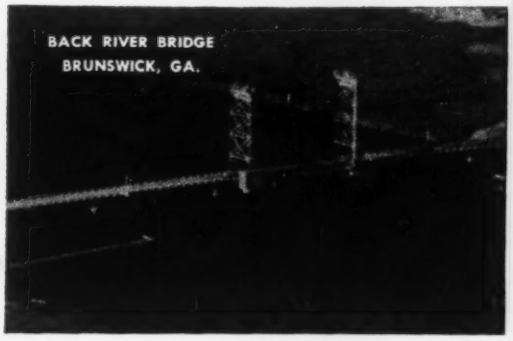


Photographs show identical lift span bridges crossing the Frederica River and Back River on the Brunswick-St. Simons Causeway, Georgia. On each, the 24′ roadway is constructed of approximately 22.5 tons of 5″ U·S·S I-Beam-Lok Open Steel Flooring with 2′-wide steel safety curb on each side.

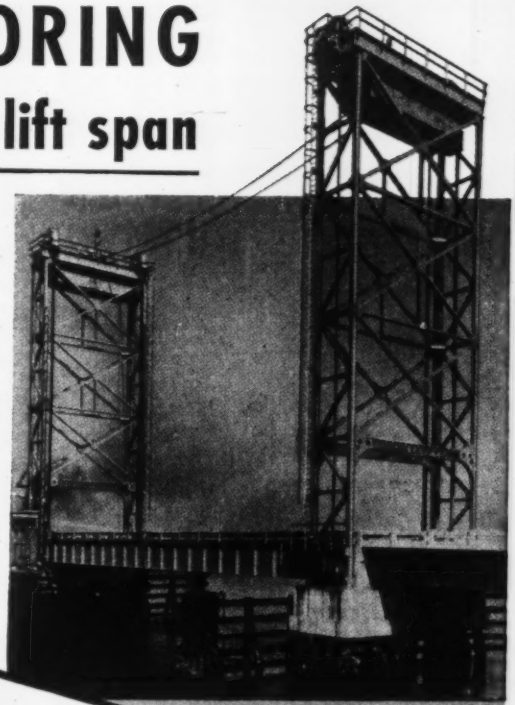
Owner: Brunswick, Ga. and Glynn County
Contractors: Tidewater Construction Corporation
Norfolk, Virginia
Designers: Sverdrup & Parcel, Inc.
Syndicate Trust Bldg.
St. Louis, Missouri

BRIDGES WERE FABRICATED BY THE AMERICAN BRIDGE DIVISION OF UNITED STATES STEEL CORPORATION

2 bridges..



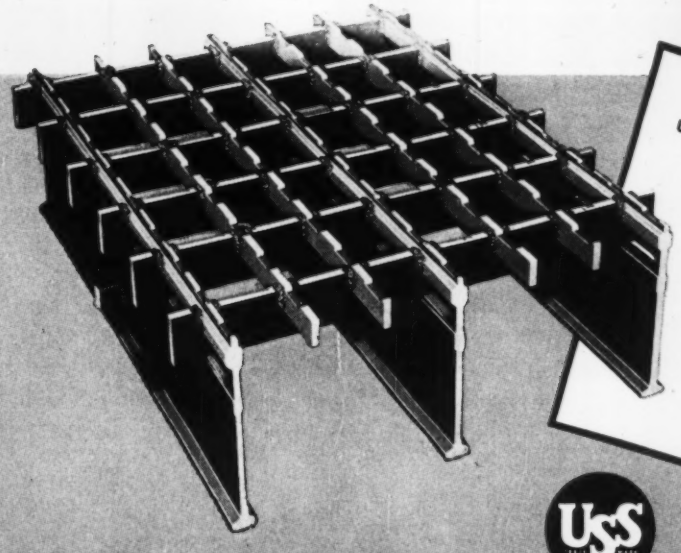
OPEN STEEL FLOORING
deadweight on each long lift span



Its light weight also makes I-Beam-Lok ideally suited for reflooring jobs because in most cases it can be applied directly to existing stringers without requiring secondary supports. I-Beam-Lok can be erected easily and speedily (on reflooring projects, with a minimum interruption of traffic) to produce a smooth riding, skid-resisting, self-cleaning, fireproof and long-wearing surface.

For more information about the time-saving, money-saving advantages of this lightweight steel flooring in bridge construction, contact the sales office nearest you.

UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.
UNITED STATES STEEL EXPORT COMPANY, NEW YORK



U·S·S I-BEAM-LOK OPEN STEEL FLOORING is available in units measuring 6′-2″ in width and up to 49′ in length. This lightweight, all-steel flooring with its strong, full 5″ depth can be applied directly to stringers on spans up to 4′ centers to permit H-20 loadings. It does not require secondary supports. This "modern floor for modern traffic" combines weight saving and reduced costs with roadway rigidity, ease of erection, a smooth, hard, self-cleaning surface and low maintenance costs. It is also available in concrete-filled type.

USS

UNITED STATES STEEL

STANDARD OIL

ASPHALT

Both traffic and road builder keep rolling when it's . . .

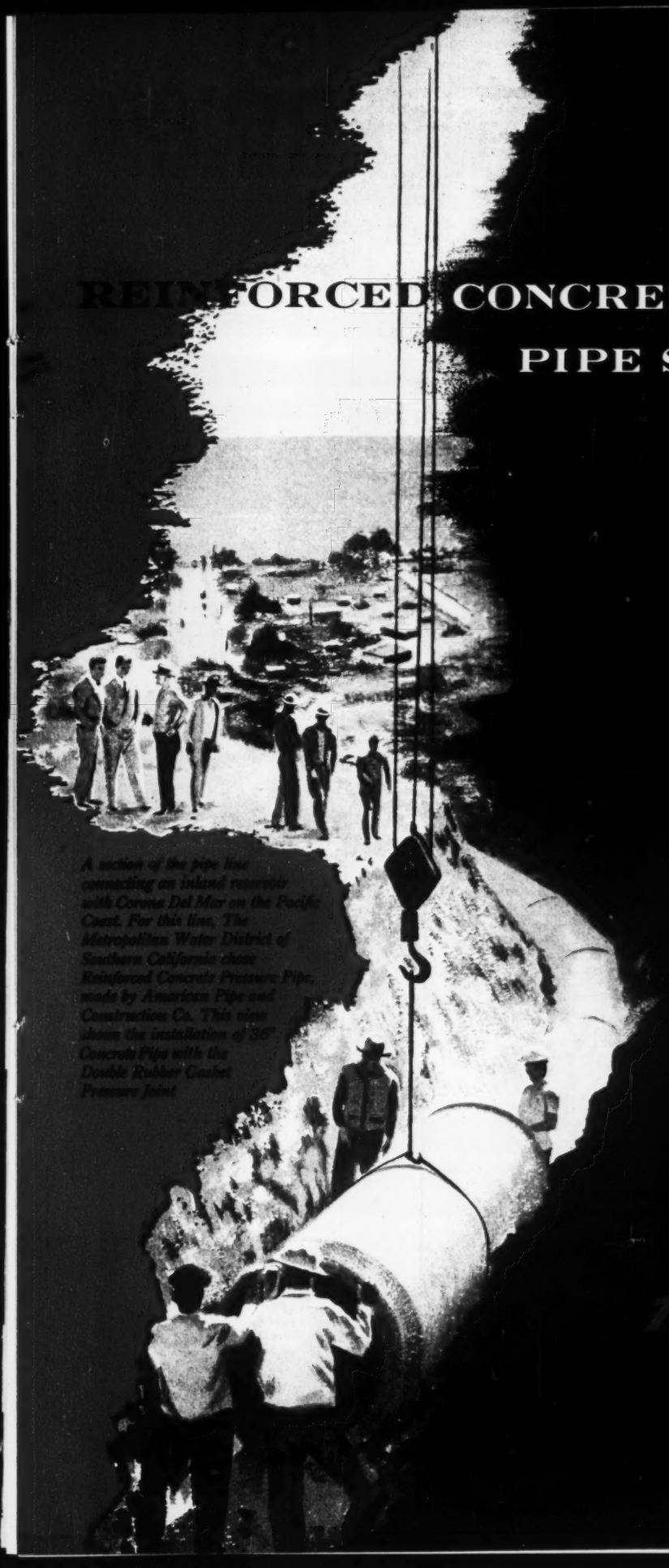
● It's a "two-way" benefit — for traffic and for road builder — when Standard Oil asphalt is used for resurfacing roads.

Because of the method of applying asphalt, the use of smaller equipment, and the quick-setting properties of asphalt; one lane can be kept open for traffic at all times. The motorist keeps rolling and likes it.

The road builder does his work faster. Easier laying of asphalt, use of lighter and faster equipment, and the rapid setting of asphalt all help to speed road construction. With five asphalt-producing refineries located throughout the Midwest, Standard Oil makes the haul to the road-building site a short one. Prompt, reliable shipments eliminate work delays. The road builder keeps rolling and likes it.

A Standard Oil Asphalt Representative serves your area of the Midwest. He is on-the-spot to give you help when you need it. You can reach him easily by phoning your local Standard Oil office. Or, write: Standard Oil Company, 910 So. Michigan Avenue, Chicago 80, Ill.

STANDARD OIL COMPANY STANDARD *(Indiana)*



A section of the pipe line connecting an inland reservoir with Corona Del Mar on the Pacific Coast. For this line, The Metropolitan Water District of Southern California chose Reinforced Concrete Pressure Pipe, made by American Pipe and Construction Co. This view shows the installation of 36" Concrete Pipe with the Double Rubber Gasket Pressure Joint

From inland reservoir to rugged coast line...

REINFORCED CONCRETE PRESSURE PIPE SAVES MONEY ALL THE WAY!

This installation, near Corona Del Mar, California, is only one of thousands where Reinforced Concrete Pressure Pipe has helped to cut over-all costs.

Steel...fully protected by densely compacted concrete...provides the necessary strength to withstand internal pressures and external loadings. It is not exposed to corrosion and the pipe is completely free from tuberculation. Smooth interior pipe walls assure consistent high carrying capacity...low pumping costs...eliminate costly cleaning and relining work...permit the use of smaller diameters. Reinforced Concrete Pipe is easy to lay and costs are kept low by using only standard contractors' equipment. Quality materials, sound workmanship, and a built-in safety-factor offer you maximum satisfaction.

You'll find a class of American Reinforced Concrete Pressure Pipe to meet your needs...carefully designed, precisely engineered, and built to meet the strictest specifications. Our 50 years of experience, our informative booklets, and our sales engineers are at your service...as near as your telephone.

Phone or write for complete information.

American

PIPE AND CONSTRUCTION CO.

Concrete pipe for main water supply lines, storm and sanitary sewers, subaqueous pipe lines

P. O. Box 3428, Terminal Annex, Los Angeles 54

Main Offices and Plant—4635 Firestone Blvd., South Gate, California. LOgan 8-2271

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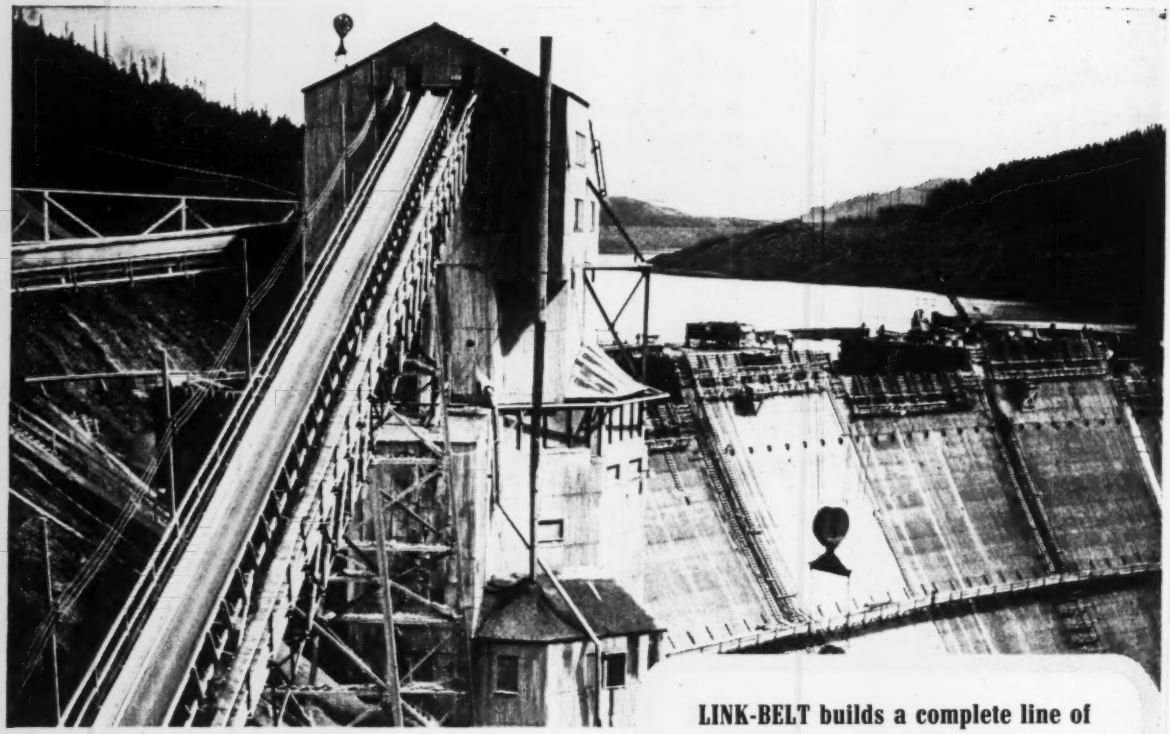
Oakland · San Diego · Portland, Oregon

TOTAL ENGINEERING



1600 foot Link-Belt belt conveyor system elevated 700 TPH of blended sand and sized aggregates to concrete mixing plant at dam construction site. Plant located 383 feet above stock-pile level.

It's your assurance of top efficiency with LINK-BELT belt conveyors

HERE'S how "total engineering" works for you when you use Link-Belt Belt Conveyors. First, Link-Belt conveyor engineers analyze your needs—then recommend the *right* components. In addition, Link-Belt can supply all related equipment — other types of conveyors, feeders, elevators, car dumpers and shakers. And Link-Belt will build your supporting structures and enclosures . . . install the job completely, if desired. Call the Link-Belt office near you for any engineering assistance you need.

LINK-BELT

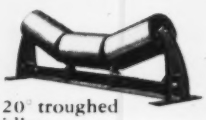
BELT CONVEYOR EQUIPMENT 13,280-G

LINK-BELT COMPANY: Plants: Chicago, Indianapolis, Philadelphia, Colmar, Pa., Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle, Toronto, Springs (South Africa), Sydney (Australia). Sales Offices in Principal Cities.

LINK-BELT builds a complete line of belt conveyor components

ALL TYPES OF ROLLER BEARING IDLERS

Return idler

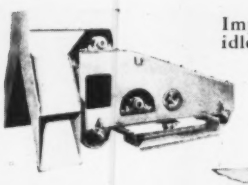


20° troughed idler

Belt-training idler

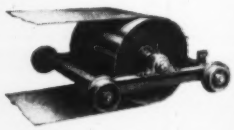
Rubber tread return idler

Impact-cushioning idler



BELT AND MOTOR PROPELLED TRIPPERS

COMPLETE TERMINAL MACHINERY



BUCYRUS-ERIE Announces the 180-W

▪ ▪ ▪ A NEW 5 CU. YD. WALKING DRAGLINE

Combining Big Output Capacity And Long Working Reach With Unusual Portability

Diesel or Ward Leonard Electric

THIS NEW 180-W offers the operating features that have proved so successful in many years of actual field performance by the outstanding line of Bucyrus-Erie walking draglines. In addition, it offers exceptional shipping and erecting ease for a machine so large — only partial disassembly necessary for moving from job to job. This means substantial savings in contract work, as well as increased value throughout its entire life.

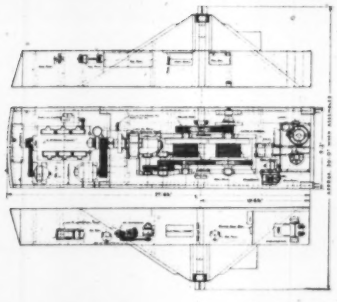
- Big output capacity from fast cycle, quick moves, steady all-weather performance.
- Long reach where needed — with 5-yd. bucket the 180-W will move material 244 ft. in a 180 degree swing.
- Knocks down into large sections for easy moving and erecting.
- Easily maneuvered to most effective working position with Bucyrus-Erie's exclusive walking mechanism.
- Large bearing area permits working on soft ground.
- Low maintenance with a minimum of moving parts.
- Simple main machinery.
- All-welded boom with tubular braces for light weight, plenty of strength.

Send for complete information on the 180-W
5-yd. bucket with 120 ft. boom
4-yd. bucket with 135 ft. boom

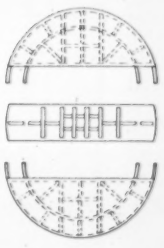
38L53C

BUCYRUS ERIE

BUCYRUS-ERIE COMPANY
SOUTH MILWAUKEE, WISCONSIN

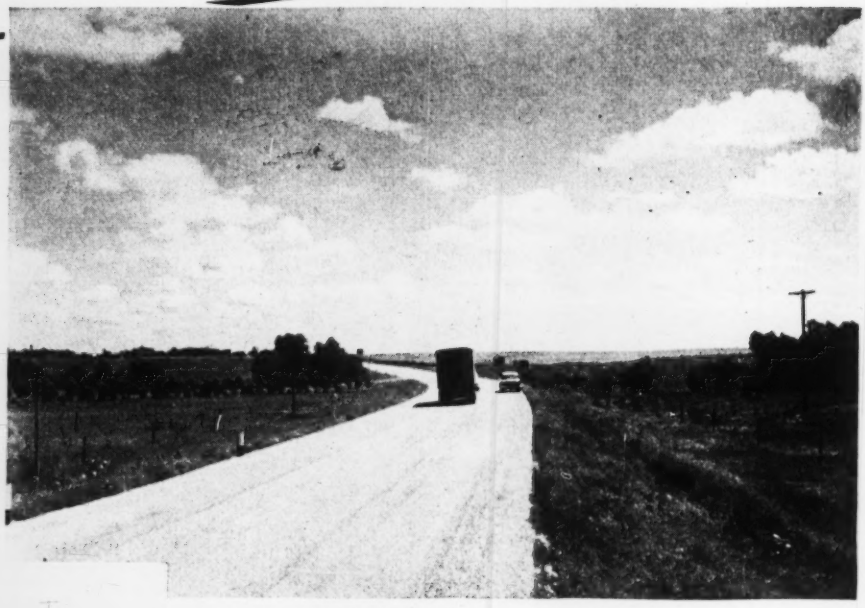


For shipment the side wings unbolt from center section of revolving frame. The main machinery remains fully assembled and in proper alignment. The entire machine is easily loaded on five U.S. railroad cars.



The base is made up of three separate welded-steel sections which are joined in the field by bolting flanges. It is easily disassembled and shipped.

Building an ASPHALT highway by the "stage construction" method



South Dakota State Highway near Faulkton, after 10 year old road-mixed Asphalt surface had been resurfaced with hot-mix Texaco Asphaltic Concrete.

Spreading and compacting the new plant-mixed Texaco Asphaltic Concrete pavement constructed by Megarry Brothers of St. Cloud, Minn.

South Dakota employed the "stage construction" method in improving this 16-mile section of State Highway with Asphalt. The first step was taken 10 years ago, when a Slow-curing Asphaltic Oil and crushed gravel were road-mixed on the highway to provide a smooth, dustless, all-weather riding surface 4 inches thick.

In 1952, after it had served traffic satisfactorily for a number of years, the road-mixed Asphalt surface provided the State with an excellent base for a heavy-duty Texaco Asphalt pavement of the plant-mixed type. The new pavement consisted of a 1-inch leveling course, spread by blade grader, and a $1\frac{1}{2}$-inch wearing surface, laid by mechanical paver. A seal coat of Texaco Rapid-curing Cutback Asphalt, covered with crushed gravel, completed the pavement.

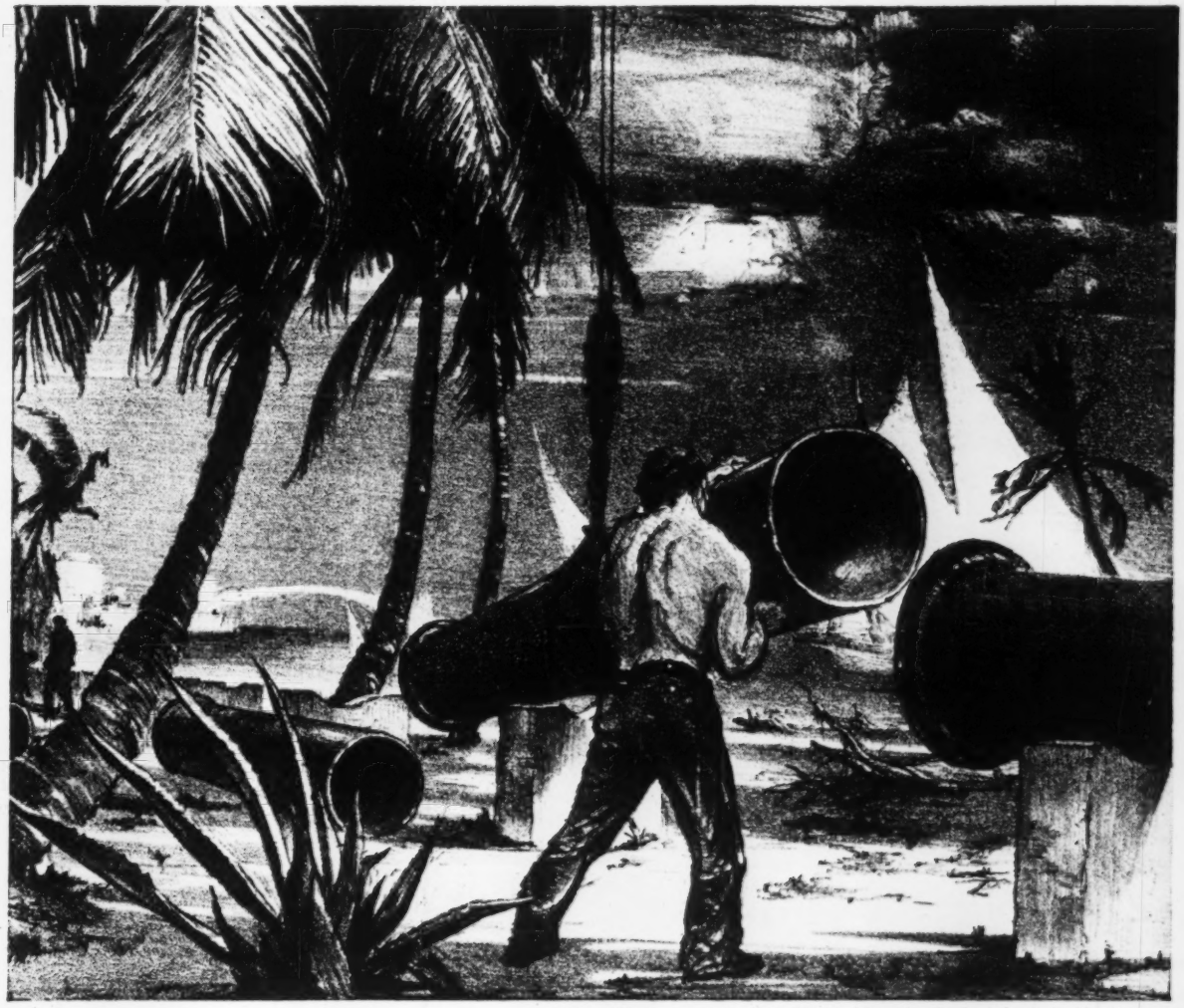
Improvement of a highway with Texaco Asphalt products by the "stage construction" method enables the road builder to keep pace with the demands of increasing traffic, while spreading costs over a number of years.

Texaco Asphalt Cements, Cutback Asphalts and Slow-curing Asphaltic Oils offer the public official a wide choice of improvements for his streets or highways. Helpful information about all of these types is presented in two booklets, which you can secure with no obligation by writing our nearest office.

THE TEXAS COMPANY, Asphalt Sales Dept., 135 E. 52nd Street, New York City 17

Boston 16 • Chicago 4 • Denver 1 • Houston 1 • Jacksonville 2 • Minneapolis 3 • Philadelphia 2 • Richmond 19

TEXACO ASPHALT



Lithographed on stone for U. S. Pipe and Foundry Co. by John A. Noble, A. N. A.

WHEN THE GROUND is unstable or a definite grade has to be maintained cast iron pipe is frequently laid on piers or pile bents. Whether above ground or underground there are installations of cast iron pipe with continuous service records measured in generations.

We are well equipped to furnish your requirements for cast iron pipe and fittings made in accordance with American Standard, Federal and American Water Works Association specifications. U. S. pipe centrifugally cast in metal molds is available in sizes 2- to 24-inch and pit cast pipe in the larger sizes with bell-and-spigot, mechanical, flanged or other types of joints.

United States Pipe and Foundry Co.,
General Office, 3300 First Ave., N. • Birmingham 2, Ala.
Plants and Sales Offices Throughout the U. S. A.

U.S.
cast iron
PIPE

▲ Cat DW20 Tractor with No. 20 Scraper hauling fill at Lincoln Air Force Base. Cycle time on 2-mile round trip: 7 minutes. Average load: 18 yards.

▲ In tough, hard-to-excavate clay, a D8 Tractor push loads a DW20-No. 20 team. Average loading time: 1½ to 2 minutes.

▲ One of two Koehring excavators with 1¾-yard clamshells, each powered by a Cat D13000 Engine. A D318 powers a Koehring with a 1-yard bucket.

◀ One of many chores for Cat No. 12 Motor Graders—maintaining haul roads from apron to stockpile of aggregate and batching plant.

CATERPILLAR

New construction on the double for Lincoln Air Force Base

Contractor's concentration on big yellow equipment an important factor in maintaining schedule

A vital link in the nation's defense chain, Lincoln Air Force Base near Lincoln, Nebraska, is the scene of an expansion program which, among other projects, includes a new parking apron and barracks. Specifications for the apron call for a base with the top 6 inches of ground with 95% compaction, blanketed with a 4-inch granular course. The 132-acre area will be covered with 20-inch-thick concrete—enough for 128 miles of standard 2-lane highway. Prime contractor is the firm of Abel-Dobson-Robinson, Lincoln, Nebraska. Thiesen Bros., Osmond, is subcontractor for the dirt moving, which involves 161,000 yards of excavation for the apron and 193,168 yards for the barrack areas.

To put the program through on schedule, both contractors are relying heavily on Caterpillar-built equipment across the board—track-type and wheel-type tractors, scrapers, motor graders and engines. Production figures bear out their confidence in the rugged yellow units, with the Cat* DW20 Tractors and No. 20 Scrapers the key machines in digging, hauling and spreading fill. Typical performance of these high-speed, big-capacity teams: on a 1-mile haul, 7 trips a team an hour hauling an average load of 18 cubic yards. Loading time per team, with a D8 pusher, 1½ to 2 minutes. The material—tough, hard-to-excavate clay. Working 12-hour days, each DW20 unit handled more than 1000 cubic yards. Each DW10, on the same haul, handled more than 700 cubic yards. John P. Thiesen says: "We started in 1922 with a Best. Through the years we have stayed with Caterpillar-built equipment. The availability of parts and the fact that so many are interchangeable make it profitable for us to standardize on Caterpillar."

D6 Tractor with No. 6S Bulldozer pulls primary finisher over 4-inch granular course for new apron. Ahead: a No. 12 Motor Grader spreading the course for the finisher.

Other big yellow equipment on the job is putting out similar profitable production. For example, two Kochring excavators with 1¾-yard clamshells are each powered by Cat D13000 Engines. Handling 60% of the aggregate used in concreting the apron, each of these units produces aggregate for 172.50 cubic yards of concrete per hour. A D318 powers a Kochring with 1-yard bucket that unloads 10 to 16 cars a 10-hour day. Robert A. Dobson says: "We feel we get a more efficient operation and maintenance with Caterpillar* units. The operators and mechanics like and are more familiar with them."

Like Mr. Dobson and Mr. Thiesen, many other contractors have found that standardizing on Caterpillar pays off more ways than one. The familiarity of operators and mechanics with one type of equipment results in more work on the job and less maintenance in the shop. The ruggedness built into all units enables them to stand up day after day in the toughest kind of going. And prompt service from one dealer is another big factor in holding down time to a minimum.

Complete information and a demonstration are available from your nearby Caterpillar Dealer. Call on him for proof that it's profitable to standardize on Caterpillar equipment.

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS

*Both Cat and Caterpillar are registered trademarks—®

Leffel

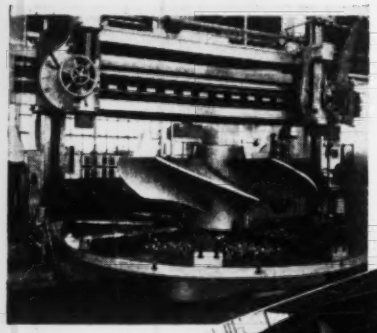
HYDRAULIC TURBINE

increases

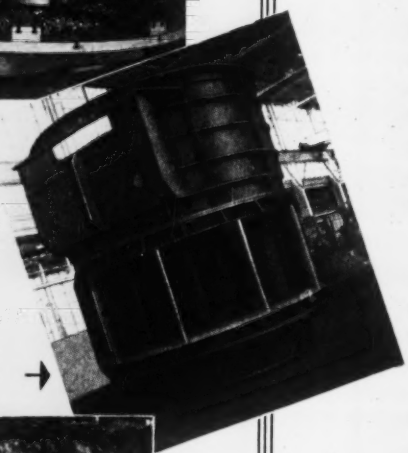
power output at

WILBUR DAM

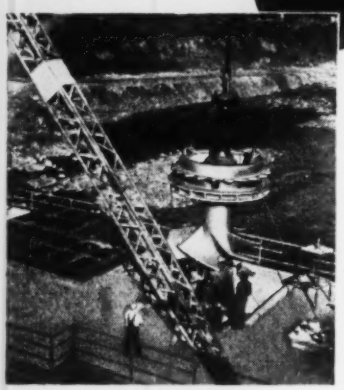
of the Tennessee Valley Authority



Cast steel propeller-type runner for the Wilbur turbine, shown on boring mill.



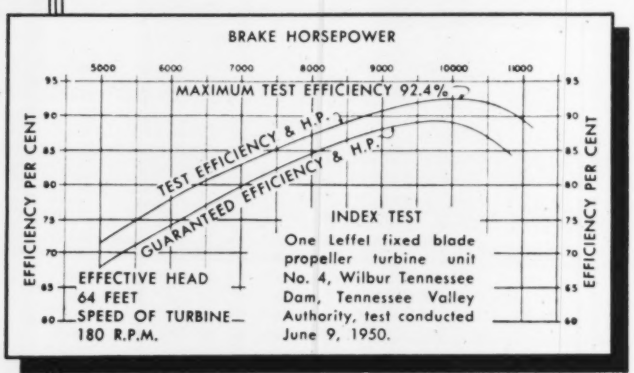
Wilbur turbine, completely assembled in the Leffel plant.



Lifting the combined runner, shaft and cover-plate during the field installation.

The Wilbur power project of the TVA is another instance where a Leffel hydraulic turbine was used for the expansion of existing power facilities. For the Wilbur installation a Leffel vertical propeller-type hydraulic turbine was used – maximum rated at 11,500 HP, under 67 feet net head, speed 180 RPM.

The Wilbur project demonstrates once again that the long-range economy and dependability of Leffel turbines make a valuable asset for any expansion or rehabilitation. Our facilities are backed by 91 years of reliable service to the water power industry. Why not let us help you with your project, whether it be expansion, rehabilitation or a new installation?



Field Test Results

1082

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THE JAMES LEFFEL & CO.

DEPARTMENT C • SPRINGFIELD, OHIO, U.S.A.

MORE EFFICIENT HYDRAULIC POWER FOR 91 YEARS

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Just check the American Concrete Institute Building Code. You will see in Sec. 505b (ACI 318-41) that American Welded Wire Fabric can be drooped continuously across the steel beams that support short-span floors. You just unroll this reinforcement into place; it comes prefabricated in long rolls of the required width. Installation is fast and easy . . . can be made with minimum crews.

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With this superior reinforcing material, you can build better short-span floors . . . and at lower cost. There are 27 standard styles to choose from.

Write to our nearest sales office for complete information.

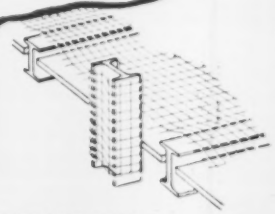
GET A JUMP ON THE WEATHER

order your Wire Fabric now!

When the weather breaks next spring, you will want to dig in *at once* on all important construction jobs. You will need plenty of American Welded Wire Fabric on hand ready for immediate use.

The best way to be sure of having enough is to stock up *now* on the sizes and types you will use.

Get in touch with your local supplier today.



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EVERY TYPE OF REINFORCED CONCRETE CONSTRUCTION NEEDS

U·S·S AMERICAN WELDED WIRE FABRIC

UNITED STATES STEEL

ONLY

Compare!

THESE MODERN BUCYRUS-ERIES WITH OTHER SHOVELS

BOOM

Two-section — light upper section, rugged lower section. No excess weight. Weight and strength concentrated where needed and close to center of rotation.

Lower boom section integral with rest of machine, through twin strut connections to A-frame. Boom feet wide spread — no sway braces or cables. No boom jacking.

HANDLE

Single, tubular, one-piece, can rotate in saddle block. No handle twist possible.

SADDLE BLOCK

Cylindrical. Rubber cushioned against impact during fast plugging of swing. No binding with flexed dipper handles.

CROWD MACHINERY

Located forward on revolving frame, close to center of rotation. Position reduces swing inertia. Accessible, protected.

TYPE OF CROWD

Quiet, positive, independent rope crowd and retract. Adapts itself to tubular handle rotation — low friction — less crowd power required.

TYPE OF HOIST

Twin dual, single-part hoist ropes, one attached to each side of dipper. Power automatically concentrated on dipper lip when needed to break through bank obstructions. No dipper bail.

CONVERTIBILITY

Shovels fully convertible to draglines of the independent motor type — no operating clutches or brakes.

THESE FEATURES ADD UP TO . . .

- **BIGGER DIPPERS PER POUND OF SHOVEL WEIGHT**
- **MORE OUTPUT**
- **LESS DOWN TIME**
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- **BROADER APPLICATION**

42L53C

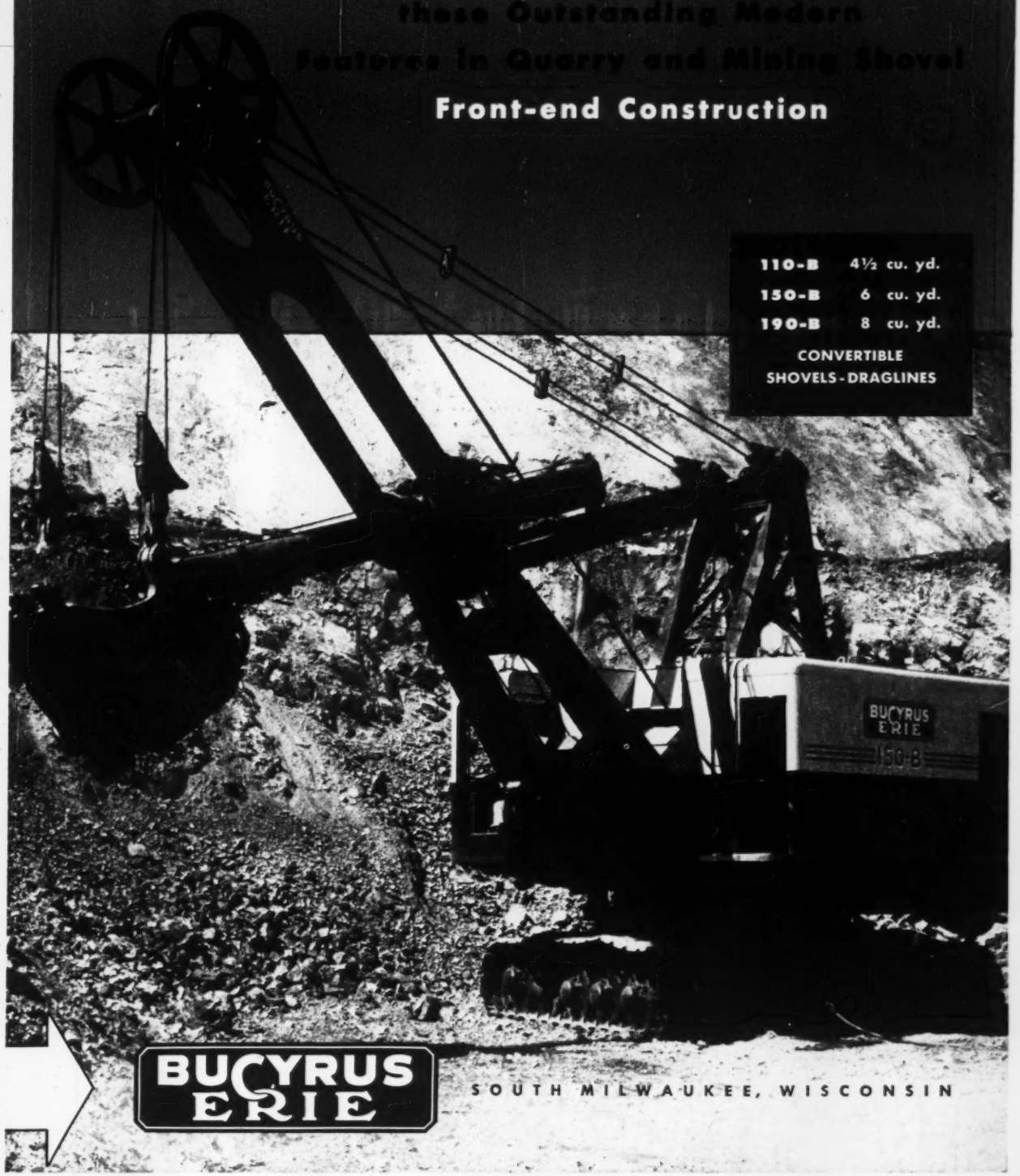
THERE ARE MANY MORE REASONS WHY THESE MODERN BUCYRUS-ERIES ARE THE FINEST QUARRY AND MINE EXCAVATORS EVER BUILT. GET THE FULL STORY TODAY.

BUCYRUS-ERIE OFFERS

these Outstanding Modern Features in Quarry and Mining Shovel Front-end Construction

110-B	4½ cu. yd.
150-B	6 cu. yd.
190-B	8 cu. yd.

CONVERTIBLE SHOVELS-DRAGLINES

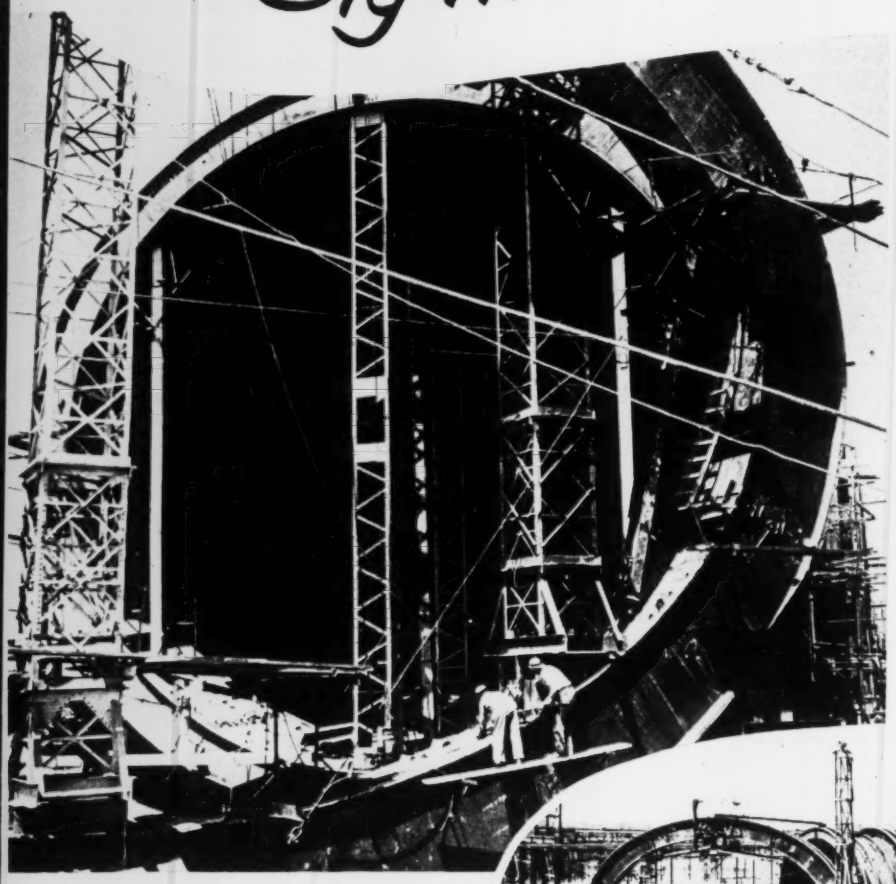


BUCYRUS ERIE

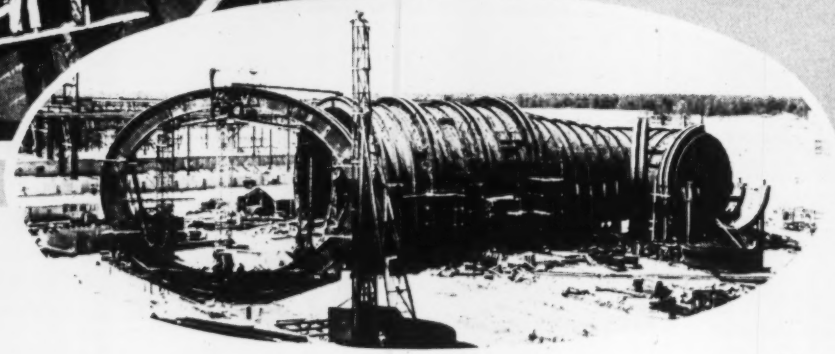
SOUTH MILWAUKEE, WISCONSIN

MAKING READY FOR A

Big Wind in Tullahoma



Advanced-design Wind Tunnel for operation at very high speeds, under construction at Tullahoma, Tennessee for the Arnold Engineering Development Center



HEAVY PLATE CONSTRUCTION

by **PITTSBURGH • DES MOINES**

Latest of the many great Wind Tunnels built by Pittsburgh-Des Moines, the Tullahoma structure employs welded plates ranging from one inch to six inches in thickness—calling upon the high degree of craftsmanship in intricate, heavy construction for which P-DM is noted. • *May we discuss your plate construction requirements, regardless of size?*

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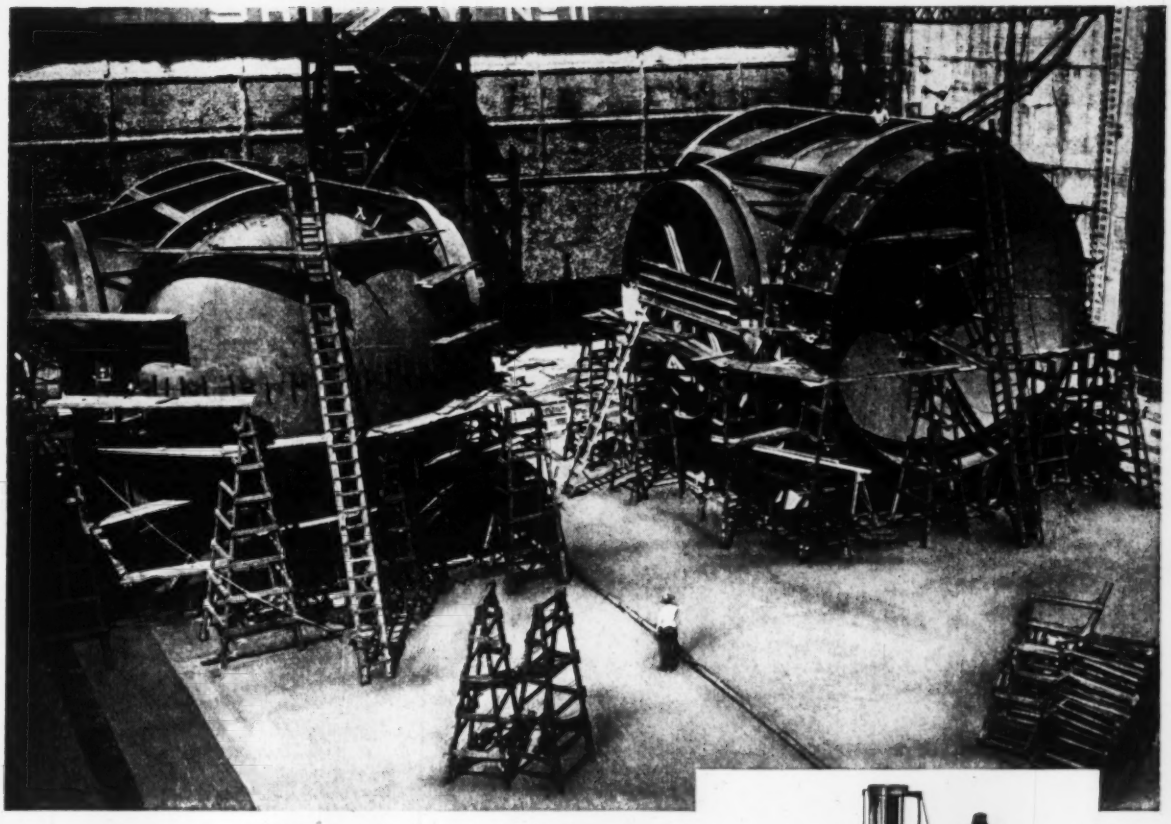
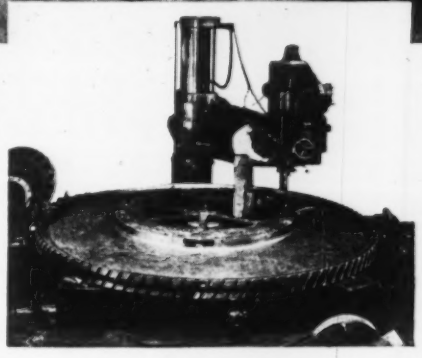


ASSEMBLING FLOW DIVERSION VALVES of an 8-foot supersonic wind tunnel for the Ames Aeronautical Laboratory of the National Advisory Committee for Aeronautics.



DRILLING A 25-TON FORGING . . . one of 11 alloy steel discs used in one of the two axial flow compressors which Newport News is constructing for the NACA's Ames laboratory.

Man-made Hurricanes

PUSH A BUTTON . . . That's all it will take to accelerate wind up to several times the speed of sound in a new supersonic wind tunnel at the Ames laboratory of the National Advisory Committee for Aeronautics, in Moffett Field, California.

The tunnel is designed to develop new aerodynamic information. Its heart is the "windmaker" . . . two axial-flow compressors which look like a giant tube 50 feet long and 24 feet in diameter, studded with small blades.

Because of the size of this unit, it is significant that the task of building these mammoth compressors was assigned to Newport News.

Newport News has also constructed two diversion valves, similar to huge plug valves, for diverting the air flow from one channel of the tunnel to another, as desired.

Large engineering and technical staffs, operating a plant with acres of brass, iron and steel foundries, five huge machine shops and other extensive fabricating facilities, make Newport News an ideal source for large equipment . . . *standard or special in design.*

Products ranging from components of rayon spinning machines to giant 165,000 horsepower hydraulic turbines operating at Grand Coulee, reflect Newport News' high integration of skill and production facilities.

Consult us on equipment for your present or future projects. Write today for your copy of "*Facilities and Products.*"

NEWPORT NEWS SHIPBUILDING AND DRY DOCK COMPANY
Newport News, Virginia

DESIGNED IN CONCRETE—*to Resist Lateral Forces*

WHEREVER EARTHQUAKES, hurricanes or tornadoes are known to occur periodically it always has been necessary to design structures to resist these powerful lateral forces. Now, confronted with the possibility of atomic blasts, it has become even more necessary to incorporate resistance in structures to destructive lateral forces.

The most logical and economical way to do this is to use reinforced concrete frames, floors and walls. Such construction is inherently resistant to lateral forces because it is continuous and integrates all structural parts. This construction eliminates any need for special members to provide resistance to these forces and makes for marked economy in the cost of buildings exposed to strong lateral forces.

An excellent example of such design and construction is the apartment building shown above. It is the 10401 Wilshire Boulevard Building in Los Angeles, designed by Architect Martin Stern, Jr. R. R. Bradshaw was the structural engineer. Both are from Los Angeles. Inasmuch as Los Angeles building ordinances require provision for resistance to seismic forces reinforced concrete construction was a logical choice. In addition the use of concrete architecturally resulted in an attractive appearance and such important advantages as durability, firesafety, low maintenance expense and ***low annual cost.***

Write today for free, illustrated literature about architectural concrete and concrete frame and floor construction. Distributed only in U.S. and Canada.

PORTLAND CEMENT ASSOCIATION
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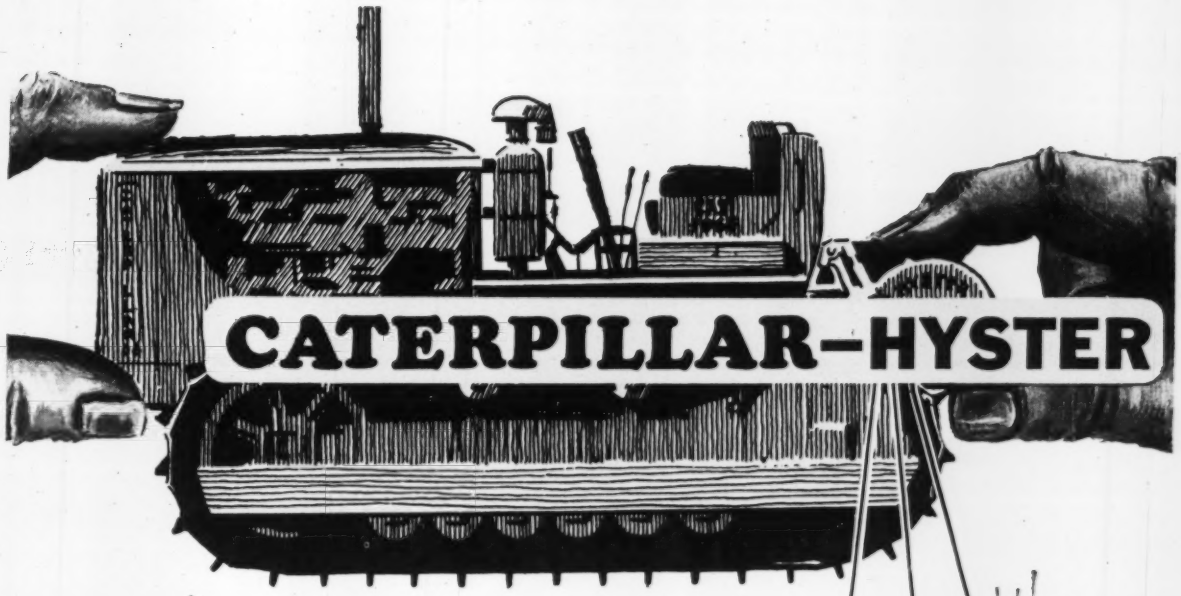
A national organization to improve and extend the uses of portland cement and concrete through scientific research and engineering field work



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...the RIGHT MATCH in equipment that is your assurance of greater tractor productivity!

For nearly a quarter century, owners of Caterpillar-built tractors have looked to Caterpillar-Hyster Dealers for the *ideas* and *properly-matched equipment* that increase tractor *productivity*.

Today, over 700 Caterpillar-Hyster Dealer stores around the world bring you the *right* tractor equipment for your job plus the two big advantages that Caterpillar-Hyster offers:

"MATCHED DESIGN," the result of close co-operation between Caterpillar and Hyster engineers, which assures the proper operation of the tractor and attached equipment *as one unit*.

"PACKAGED" EQUIPMENT, which brings you *all* the right equipment on ONE order—plus the advantages of dealing with ONE service for all your needs, such as *one* financial plan, *one* source of parts and service, *one* source for ideas on product application.

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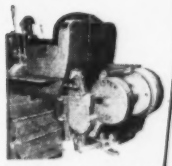
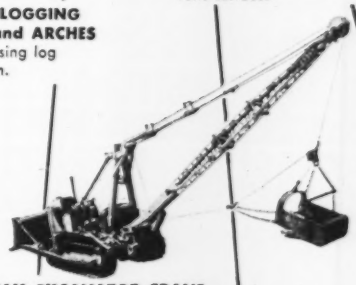


HYSTER WINCHES 19 types and sizes for every application—in construction, mining, logging and manufacturing industries.

HYSTER TRACTOR DONKEY and YARDERS—hoists for all types of pulling and hoisting jobs.

HYSTER GRID ROLLER—the basis of a revolutionary new road rebuilding method which salvages all the old bituminous material, also compacts base, rolls surface.

HYSTER LOGGING SULKY and ARCHES for increasing log production.



HYSTAWAY EXCAVATOR-CRANE—mounts on used or new tractors... convertible to shovel, backhoe, dragline, clamshell, crane, piledriver, *plus bulldozer!*

THERE'S PROFIT IN HYSTER POWER

Wherever you are... there is a Caterpillar-Hyster Dealer near you

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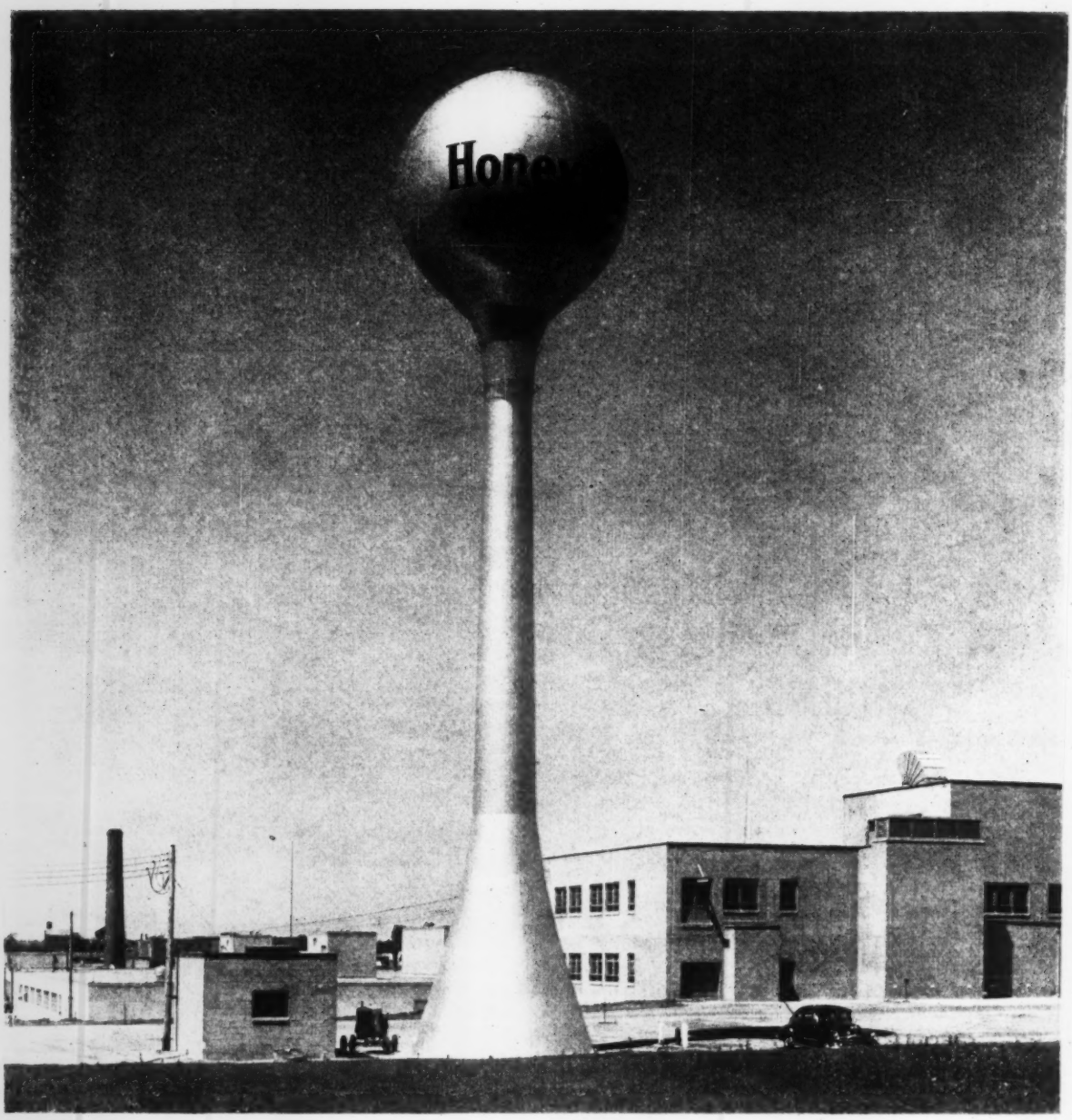

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The 75,000-gallon Horton Watersphere® shown above was installed as part of a new water system at the Minneapolis Honeywell Regulator Company plant in Minneapolis.

Water for the plant is obtained from two wells sunk to a depth of approximately five hundred feet. The wells were dug, and the Watersphere installed, as the most economical means of providing a dependable water supply for general service and fire protection at the plant. Formerly, all water for these purposes was obtained from the city water mains.

Modern, streamlined Waterspheres are built in standard capacities from 25,000 to 250,000 gallons. Write our nearest office for estimates or quotations on a Watersphere or a Horton elevated tank for your water system.

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Atlanta 3 ..... 2167 Healey Bldg.
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PLASTIMENT*
CONCRETE Ddensifier

CONTROLS SET AND REDUCES WATER CONTENT WITHOUT INCREASING AIR CONTENT FOR

- **GREATER UNIFORMITY**
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- **SURFACE HARDNESS**

*Plastiment consistently produces higher structural values in concrete because it limits and controls the growth of water-consuming cement gels during mixing and placing of concrete. This action reduces the water-cement ratio and retards the set of **all** concretes, plain or air-entrained, regardless of type of cement or aggregate. Uniformity of set and water content (the governing factors of uniform concrete quality) are made possible by changing Plastiment proportions with concrete-placing-temperatures and field conditions.

Controlled set and uniformly low water content — exclusive with Plastiment — means less segregation, shrinkage, cold joints and other defects, greater uniformity and resistance to abrasion, cracking and leakage.

Write for your copy of "Plastiment, Concrete Densifier." For specific information on how Plastiment can benefit your own concrete projects, check with our engineering staff today.

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BRANCH OFFICES: PITTSBURGH, SALT LAKE CITY, MONTREAL, PANAMA, CHICAGO • DEALERS IN PRINCIPAL CITIES

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How the best product in its field has been made still better

Not overnight, of course—but by a series of improvements gained through research and development resulting in *modernized* cast iron pipe. Tougher, stronger, tuberculation-proof pipe with sustained carrying capacity. Centrifugally cast and, when needed, centrifugally cement-lined.

All of our member companies have centrifugal casting facilities for producing tougher, stronger *modernized* cast iron pipe. All can supply this pipe with cement lining centrifugally applied, resulting in sustained carrying capacity, reduced friction loss and lower pumping costs.

If you want the most efficient and economical pipe ever made for water distribution, your new mains will be laid with *modernized* cast iron pipe with either bell-and-spigot or mechanical joints. Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Ave., Chicago 3.

CAST IRON

The Q-Check stencilled on pipe is the Registered Service Mark of the Cast Iron Pipe Research Association.

Modernized **cast iron**

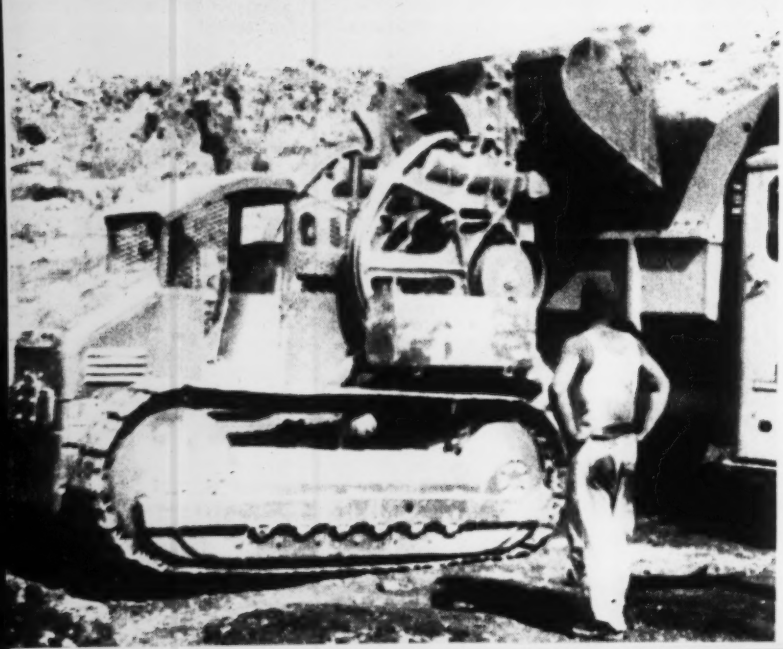
This cast iron water main, uncovered for inspection, is in its 106th year of service in Boston, Mass.—one of more than 45 cities with century-old water or gas mains in service.

pipe for Modern Waterworks Operation

EIMCO

WORLD'S FINEST TRACTOR EXCAVATOR

The 105 at work excavating unconsolidated material. The machine shown here is on a stripping job and is equipped with a 1½ cubic yard bucket equipped with long digging lip and teeth. The extra heavy design of this unit provides the necessary strength to use the machine for actual excavation work. Speed in loading is governed by the travel distance to the truck. With trucks in close the Eimco 105 can easily load at the rate of 6 to 8 yards per minute. Below—The operator sits up front in the 105 where he can get the best view of the work. Discharge of the bucket is controlled by the operator through the Eimco two speed bucket transmission.



Yes! The Eimco 105 is the world's finest tractor excavator! This is the first unit ever designed and built from the ground up with the purpose of performing as a base for heavy-duty attachments to its own frame so that it could be used efficiently for handling many jobs in addition to hauling around other equipment. The 105 is designed for heavy shock vertical loads as well as normal loads imposed through straight drawbar pull.

The Eimco 105 operates freely under all loading conditions, will dig, excavate or bulldoze on even or uneven ground because of its full oscillating track feature even with the bucket attachment.

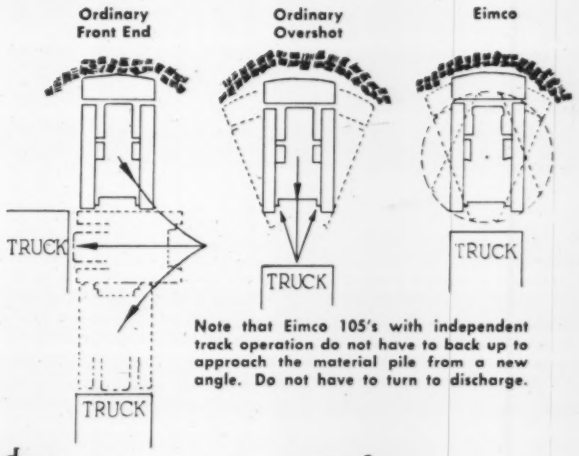
WITH COST SAVING ADVANTAGES

SAVES TIME: Simple, conveniently located handles held in one hand control all movements. Push for forward — pull for reverse — twist for spin turns. This easy control simplifies the operator's work — eliminates turning to dump — eliminates foot clutches and hand shifting and pull brakes — keeps the trucks up close and speeds up the loading cycle.

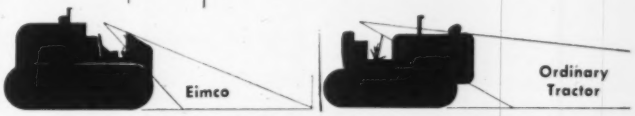
GREATER DEPENDABILITY: Simple, strong construction of the great new Eimco transmission provides greater dependability. This compact unit contains all of the gearing and clutches for speed changing and full independent reversal of each track. Every moving part is pressure lubricated. The oil-cooled, positive engagement clutches never need adjustment.

BETTER VISABILITY: The operator in the Eimco 105 sits up front where he can see the work that's being done.

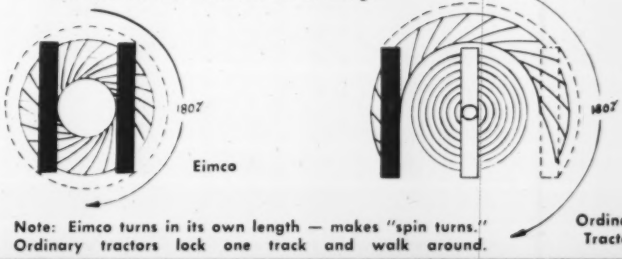
GREATER FLEXIBILITY: The 105 covers the upper bracket range of work done by several models of ordinary tractor equipment in several different price and weight brackets. With the 105 priced with the lower of this group, yet powerful enough to do many of the jobs for which the larger, more expensive, units are employed.



Note that Eimco 105's with independent track operation do not have to back up to approach the material pile from a new angle. Do not have to turn to discharge.



The operator sits up front where he can see the work his machine is doing.



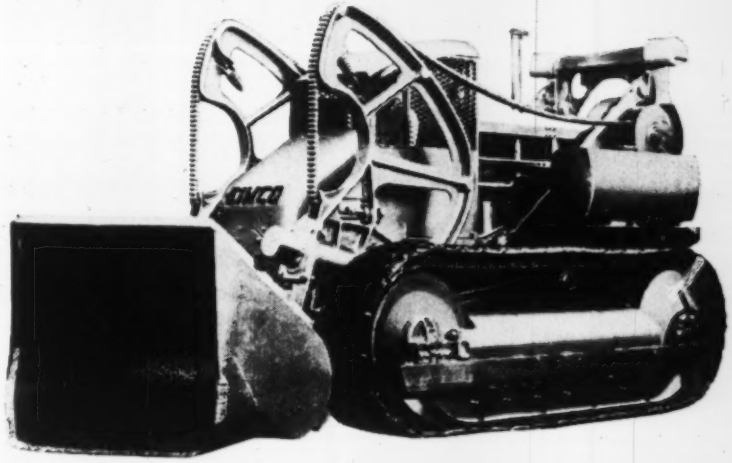
Note: Eimco turns in its own length — makes "spin turns." Ordinary tractors lock one track and walk around.

THE EIMCO CORPORATION

Salt Lake City, Utah, U.S.A.

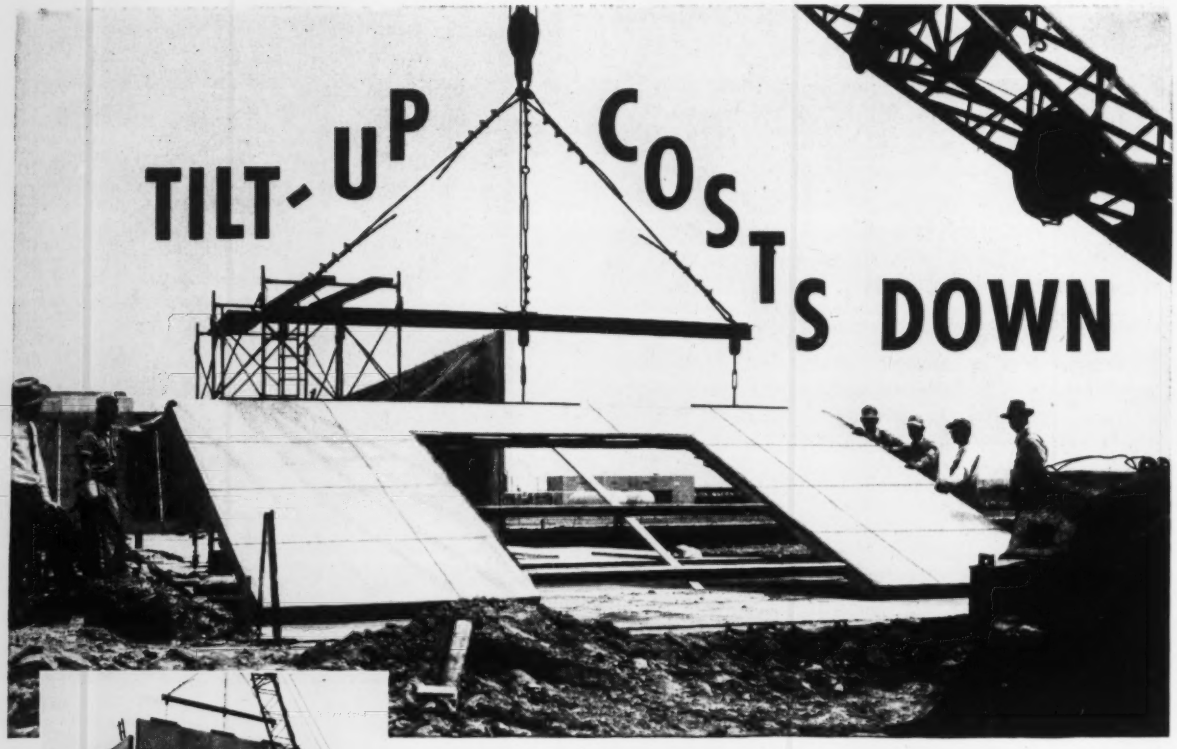
Export Office: Eimco Bldg., 52 South St., New York City

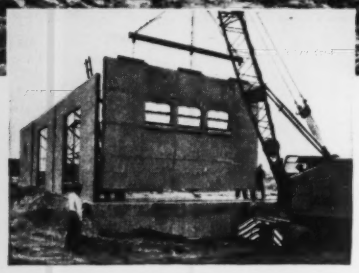
STRONGER CONSTRUCTION THROUGHOUT: The 105 is made of steel — not cast iron. There is quite a difference in these two construction materials. Cast alloy steel as used in the 105 is not subject to shock cracks even under severe operating conditions. Steel stands strains and stresses imposed by heavy loads without danger of failure. The Eimco 105 is the only crawler unit made of steel and gives you a superior machine with longer dependable life and lower maintenance costs. This is the machine for your next heavy job. Let us send an Eimco engineer to tell you the facts.



The Eimco 105 — world's finest tractor-excavator

TILT-UP COSTS DOWN





CITIES SERVICE COMPANY WAREHOUSE
Fairfax Industrial District, Kansas City, Kansas

Architect:
ANDREWS & HUTCHENS, Kansas City, Mo.

General Contractor:
H. H. FOX CONSTRUCTION CO., Kansas City, Mo.

Concrete Contractor:
ROHRER CONTRACTING CO., Kansas City, Kansas

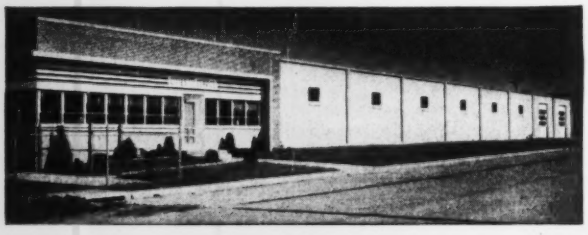
Ready-Mix Lone Star Concrete:
CONCRETE MATERIALS, INC., Kansas City, Kansas

Cities Service Kansas City Warehouse Illustrates Tilt-up Advantages

● Adaptability of tilt-up construction to a wide range of uses and architectural effects is exemplified by numerous recent structures, concreted with Lone Star Portland or 'Incor' 24-Hour Cement, as job conditions dictated.

This new Cities Service Kansas City Warehouse, with 45,000 sq. ft. of floor space, is as pleasing to the eye as it is to the pocketbook. Concreted throughout with Lone Star Portland Cement, the 31 panels, each 24′ x 14′9½″ x 5″, were cast on the concrete floor, lifted into position in jig time.

Tilt-up construction saves construction time, reduces form and labor costs, often makes possible important economies, not only in one-story industrial and commercial buildings but in other types of buildings, from homes and garages to multi-story structures.



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CIVIL ENGINEERING

DECEMBER 1953

THE MAGAZINE OF ENGINEERED CONSTRUCTION

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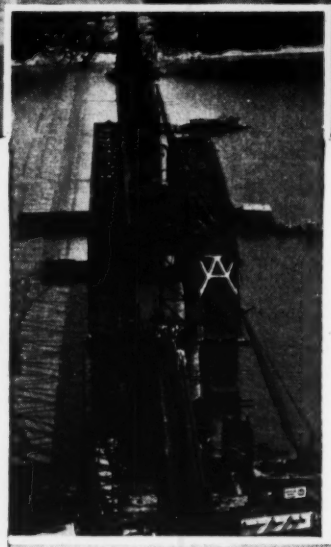
BRIDGE MODERNIZED

with minimum interruption in traffic



AMERICAN BRIDGE uses unique method in replacing 61-year old structure on Illinois Central's busy main line

ONE of the most interesting modernization jobs in recent years is the new superstructure for Illinois Central's busy main line bridge over the Ohio River at Cairo, Illinois.

To accommodate today's heavier, faster traffic, this important railroad replaced its 61-year old nine-span structure with 12 modern spans.

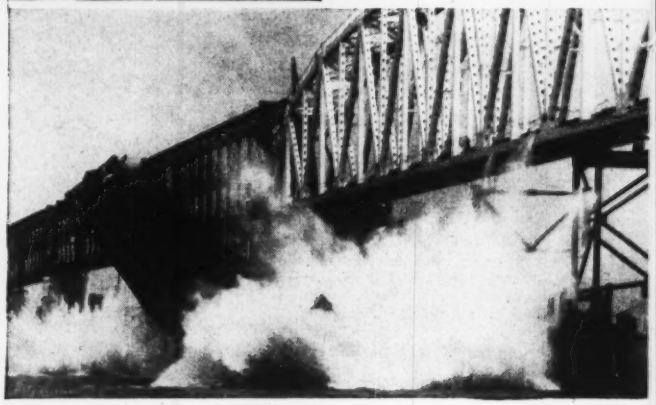
American Bridge, because of its skill, know-how and wide experience, was the logical choice to perform the major construction feat of building the new superstructure on the original piers with a minimum interruption in traffic.

The first old span of the bridge was rolled off its piers onto temporary falsework and the new 518-foot, 1,700-ton span moved into position and opened to service after a traffic interruption of only 20 hours. The old span was launched like a ship into the river 100 feet below for easy removal. The same procedure was followed span by span until the entire bridge was completed.

While this is the first time this method has been used on a job of such magnitude, it is a typical example of the part American Bridge is constantly playing to help our vital railroad systems meet the needs of growing America.

INTERESTING FACTS

- 6 deck-truss spans, 197' 7"
- 4 thru-truss spans, 400' 11½"
- 2 thru-truss spans, 518' 11"
- Bridge is single track.
- Steel used, 10,000 tons.
- Erecting procedure: Illinois Central R. R. and American Bridge
- Consulting Engineers: Modjeski and Masters.



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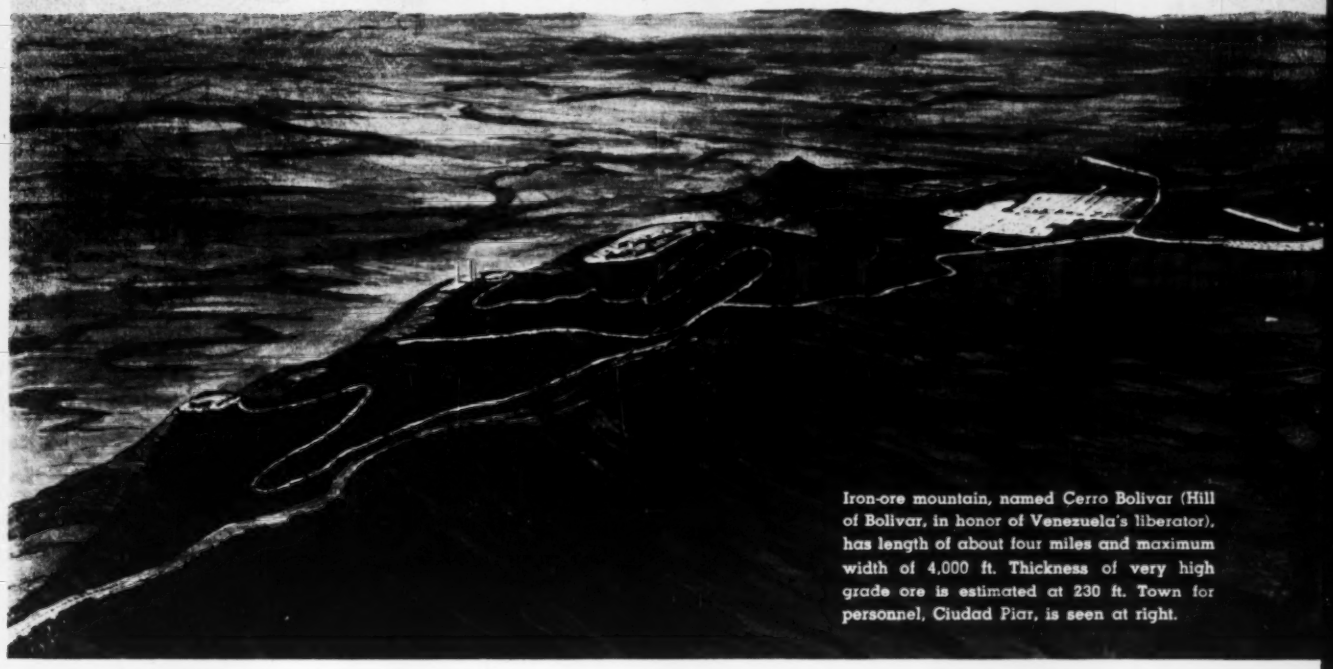
CIVIL ENGINEERING

DECEMBER 1953

THE MAGAZINE OF ENGINEERED CONSTRUCTION



Iron-ore mountain, named Cerro Bolivar (Hill of Bolivar, in honor of Venezuela's liberator), has length of about four miles and maximum width of 4,000 ft. Thickness of very high grade ore is estimated at 230 ft. Town for personnel, Ciudad Piar, is seen at right.

Vast and varied engineering works develop Venezuelan iron-ore deposit

W. W. WANAMAKER, M. ASCE, Chief Engineer, Orinoco Mining Co., New York, N.Y.

A survey of new iron ore deposits in many parts of the world was initiated by the U.S. Steel Corporation in 1944 under John G. Munson, vice president in charge of raw materials, with the support of Benjamin F. Fairless, president, and B. H. Lawrence, vice president, engineering. The First and Second World Wars had used up the most easily mineable iron ores at an unprecedented rate. In 1945, Mack C. Lake, now president of U.S. Steel's Orinoco Mining Co., and a long-time M. A. Hanna Co. geologist, was engaged by the Oliver Iron Mining Co., a subsidiary of U. S. Steel, to supervise the exploration of iron ore deposits in Venezuela. The area first explored, which Venezuela had considered the only potential iron-ore area, lies south of the Orinoco River and east of the Caroni. Eethlehem Steel has its El Pao mine in this region. Several deposits were found and two concessions were acquired, but neither measured up to expectations.

Mr. Lake and his two principal geologists, K. Burrell and F. Kihlstedt, then conceived the idea of aerially photographing the area south of the Orinoco, but west of the Caroni, not particularly remote, and not generally considered to hold much promise of extensive ore deposits. In early 1947, a contract was entered into with Fairchild Aerial Surveys, Inc., to photograph an area of about 11,000 sq miles and to prepare maps on a scale of 1:40,000. A methodical and intensive study of these aerial photographs then began. Even before all the new area had been photographed, the geologists' attention was attracted to two small mountains or hills, known locally as La Parida and Arimagua.

On April 3, 1947, Mr. Kihlstedt, now mining engineer of the Orinoco Mining Co., the U.S. Steel subsidiary organized to construct and operate the Venezuelan works, started in a jeep for La Parida. The next day he struggled up its steep northern slope

FIG. 1. Routes ore will follow to two main points of use in United States are indicated by heavy dashed lines.

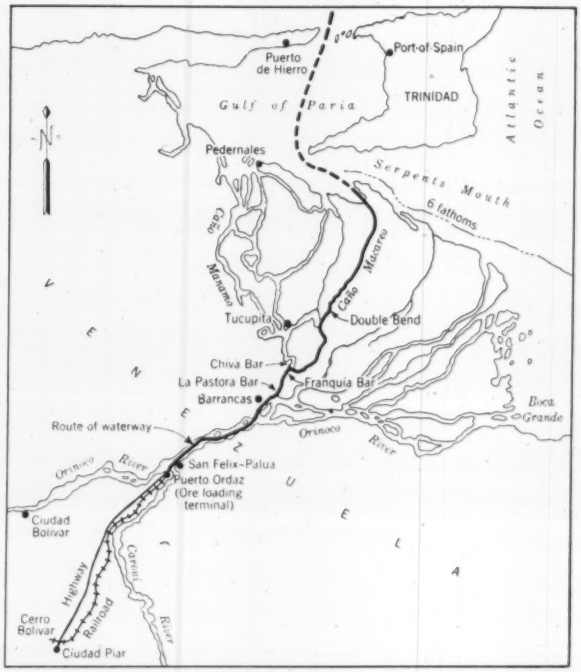


FIG. 2. Within Venezuela ore will move from source at Cerro Bolivar (lower left) by rail for about 90 statute miles to Puerto Ordaz on Orinoco River, and then by water for 178 statute miles through dredged channel in Orinoco and Macareo to tidewater.

encrusted in iron ore, and saw ore exposed in lavish masses by great slides as high as 200 ft. Immediately he set up a reference point in the ore and took steps to file his claims. Title was obtained by denouncement, and early in 1948 the name of the hill was changed to Cerro Bolivar, or Hill of Bolivar, in honor of the great liberator of Venezuela.

Drilling was started in July 1947, and by the latter part of that year it was clear that an immense deposit of high-grade iron ore had been discovered. Its length is about four miles, its maximum width about 4,000 ft, and its average thickness about 230 ft. The average grade (dry analysis) is about 63.50 percent iron, with the natural iron content calculated to be about 58 percent. The ore is a mixture of hematite, limonite, and a small percentage of magnetite, and is practically free of sulphur and other objectionable elements.

Cerro Bolivar lies 88 land miles from the junction of the Caroni and Orinoco Rivers which, in turn, is 154 nautical miles (178 statute miles) from tidewater. See maps, Figs. 1 and 2. Approximate routes and distances to the Fairless Works at Morrisville, Pa., and to Mobile, Ala., are shown in Fig. 1.

Studies indicated that the ore could be delivered at these ports in competition with Labrador ore and Lake Superior taconite, and that Venezuelan ore should find markets in the Gulf area, on the East Coast, and in the Pittsburgh and Youngstown areas. Accordingly, U. S. Steel planned to develop this ore body and to ship initially at the rate of 5 million gross tons annually, with provision for expansion to 10 or more million tons annually.

Ore Mined with Power Shovels

The ore, which is practically free of overburden and which in some respects is an outer shell of the mountain, is to be mined with power shovels, loaded into dump trucks, and dumped from ore trucks into railroad cars at the top of the hill. A single-track railroad, about 90 miles long, has been virtually completed from the top of the mountain to Puerto Ordaz, the junction of the Orinoco and Caroni rivers, as described in more detail in Mr. Barlow's article. The tracks have their predominant grade favoring the load.

At Puerto-Ordaz, the ore is to be transferred from the railroad cars by a car dumper and passed through crushers to a belt conveyor system which will deliver it to a stockpile. From there a reclaiming system will remove the ore and load it directly into ocean-going vessels at dock side. Suitable docks, service and maintenance facilities, towns, and utilities are being provided. The ocean-going vessels will reach the port, which lies about 154 nautical miles inland, by way of a channel 26 ft deep at low water, which has been dredged in the river.

In the Cerro Bolivar area, the ore will be mined by two 8-cu yd Bucyrus-Erie 190-B electric shovels, and one 6-cu yd Lima diesel-powered shovel. They will operate initially in three separate localities in 50-ft benches on top of the mountain and near its western end. The shovel capacity is ample to produce 5,000,000 long tons per year on a single-shift basis.

Drilling will be done with Type 50-T Bucyrus-Erie churn drills and the Joy Champion rotary drill, Type 58-BH with 7 3/8-in. hole. Other drilling machinery will no doubt be used in the development stage, including jackhammers, Joy DM-10 or DM-4 Drillmobiles with 4 in.-diameter bore and heavy wagon drills.

Sixteen 20-cu yd Mack trucks, Type LRSW, will be shovel loaded and will haul the ore initially to two structural-steel loading docks located about one-half mile distant. Here the ore will be dumped directly into the ore cars on the rail tracks.

It is apparent from what has been said that this mining operation is the reverse of normal open-pit mining; that is, the top of a mountain and a good proportion of its side slopes will be excavated, instead of digging down into the earth. The uppermost ore is at El. 775 meters (2,543 ft); a large tonnage lies above the 700-m (2,296-ft) contour; and ore lies down the

mountain even below the 600-m (1,968-ft) contour, which is still 300 m (984 ft) above the base of the mountain. Hence the trucks and the rail cars will be running downhill under loads, and accordingly braking action is of paramount importance. The trucks selected will be equipped with a 300-hp Cummins diesel engine, the Twin Disc converter retarder, and the Parkersburg Hydrotarder.

Special Braking System Used

The ore cars are being constructed by the Magor Car Corp. of New Jersey. They are 4-axle, carry a net load of 90 long tons, and weigh about 250,000 lb loaded. They are equipped with standard Westinghouse air brakes with an additional straight air line which makes it possible to apply the brakes and charge the reservoirs at the same time and thus provides an added safety factor. This is a unique system that could be adopted because the cars will not be in interchange.

The cars are expected to move in 93-car trains initially, and later in 123-car trains, from an assembly yard on top of the mountain at its western end at an elevation about 1,000 ft above its base. From there the trains will run down a 3.1 percent grade to the savannah and continue, generally on a down grade, to the port. The locomotives are Baldwin-Lima-Hamilton diesel-electric, 3-axle trucks, 180-ton, 1,600-hp units. Three units are expected to handle a loaded 123-car train. Although the maximum adverse grades on the track are 0.5 percent, they are so short as not to be governing, and the ruling grade with the equipment described is 0.2 percent.

The tracks are designed for operation at speeds of 45 miles per hour. The average round-trip running time between the assembly yard at Cerro Bolivar and Puerto Ordaz is calculated at 7 hours 50 minutes.

Ties, with few exceptions, are creosoted Southern pine or gum, shipped from the United States. A small number of native ties were used, but their adoption in quantity was not possible because of lack of local production, unsuitability of the wood, and the absence of facilities for creosoting.

The number of trains per day will be small (2 loaded and 2 empty trains per day for 5,000,000 tons per year) and even though the system could be operated by either an automatic or manual block signal system, it was decided for reasons of economy in operation to adopt the centralized traffic control system (CTC). Since there are four long passing tracks, with CTC the capacity of the system will approach that of a double-track road.

The Orinoco Mining Co. has its own high-frequency radio system between Caracas, Ciudad Bolivar, Puerto Ordaz, Cerro Bolivar, and the route from the mine to tidewater, designed and installed by the Radio Corporation of America. Experience gained in operation of this system indicated that radio signals could be used to actuate the CTC, thus avoiding the construction of a costly wire line 90 miles in length. This system was designed by Union Switch and Signal Co., RCA, and the Orinoco Mining Co.'s consultant, Paul F. Godley, and is now being installed.

One of the most important features of track operation will be the control of the heavily loaded ore trains on the 7-mile down grade, averaging 3 percent, from the mountain assembly yard to the savannah. Two run-away tracks are being provided on this section, with switches set for through track operation. If speed exceeds 21 miles per hour through an electrically timed section preceding a run-away track, the switch is thrown and the ore train leaves the main track, to be stopped by the adverse grade of the run-away track.

Construction of the railroad and highway from Puerto Ordaz to Cerro Bolivar was completed on schedule by November 1, 1953.

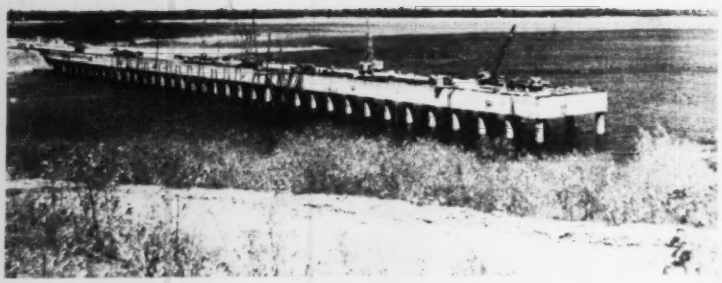
Two Power Plants Built

A power plant, consisting of two 2,500-kw Nordberg diesel-electric units, is under construction at the base of Cerro Bolivar to furnish power at the town site and for the operation of the electric shovels at the mine. At the port, where the load demand is considerably greater, a steam plant is in operation with an initial installation of two 6,000-kw General Electric units, and provision for a third. This plant was designed by the International General Electric Co. in cooperation with the consulting firm of Gibbs & Hill of New York, N. Y. The boilers are oil fired, rated at 75,000 lb of steam per hour at 400-lb pressure and 750-deg temperature. Water will be taken directly from the Caroni River through an intake equipped with traveling screens.

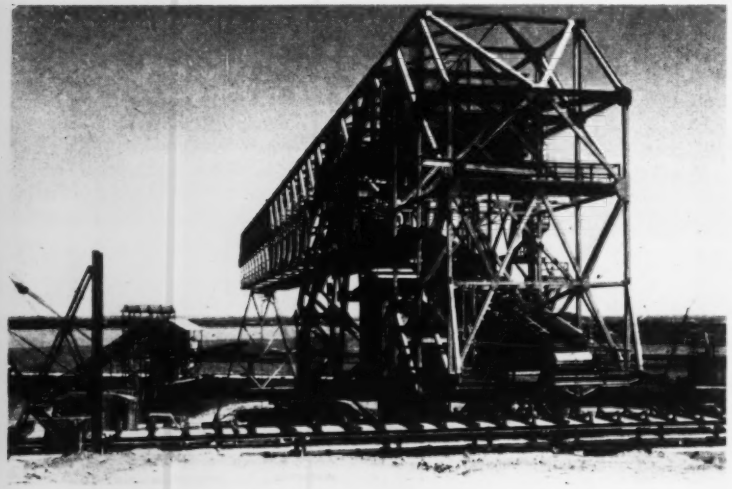
The dock at the rail terminal is located at the mouth of the Caroni River, just above its junction with the Orinoco. The range of river stage between low and high water is 39 ft.

A type of dock designed by the DeLong Engineering and Construction Co. was finally determined upon, as described in Mr. Maxton's article in CIVIL ENGINEERING for May 1953, page 40. The savings in time of erection over a conventional type of dock were very great and there was assurance that the first section of this dock would be ready to receive initial shipments of construction materials to the site. A contract was entered into with Raymond Concrete Pile Co. which in turn contracted with the DeLong Engineering and Construction Co. for the fabrication, delivery, and erection of this dock. The contract with DeLong was entered into February 10,1952, and the first dock section was launched April 19 and arrived at Puerto Ordaz June 1.

From Cerro Bolivar ore will be moved by rail about 90 miles to port on Orinoco River. Tracks are designed for operation at 45 miles per hour. Average running time for round trip is calculated at about 8 hours. Five million tons of ore per year can be moved by running two loaded and two empty trains per day, easily managed by use of four long passing tracks.



Dock at Puerto Ordaz had to be put in service quickly for handling construction supplies and equipment. Special portable dock, designed by DeLong Engineering and Construction Co., was towed from United States in sections and erected by jacking steel caissons down through deck.



Ore handling plant is located at Puerto Ordaz instead of at Cerro Bolivar so as to permit later handling of ore from other sources if desired. Here ore stocking bridge for ground storage is seen under construction in foreground. In distance at left is control house, with dock-side conveyor running from it to right.

All housing was designed by Venezuelan architects of native materials with particular attention to termite resistance. Houses are single story, concrete block, with concrete floors and flat concrete roof. Air view shows Ciudad Piar under construction.

Eight days later a ship was unloaded at the dock, although it was as yet not completed.

Crushing Plant at Puerto Ordaz

One of the basic plans considered was to locate the primary crusher at the top of the mine and to transport the ore by truck to drive-over dump pockets and crush it to minus 6 in., then to convey it by belt conveyors down the mountain side to the savannah, where it would be prepared for shipment. This plan was discarded in favor of the present plan of locating the crushing plant and ore-handling system at Puerto Ordaz, where it is available for handling ore from deposits other than Cerro Bolivar.

The outstanding features of the ore-handling system are worthy of emphasis even though they are described in detail in Mr. Millard's article. The system was designed and manufactured, and is being installed by the Link-Belt Co. and its associates and subcontractors. Some of its unusual features are:

1. Its enormous capacity of 1 67 tons of ore per second.
2. The size and speed of the car dumper, designed and built by the Wellman Engineering Co. and probably the most rugged ever built, considering the weight of the loaded ore cars and the time cycle.
3. The massive primary gyratory crusher built by Allis-Chalmers and installed in a pit over 100 ft deep.
4. The reclaiming tunnels under the stockpile, with continuous slot, and the rotary plows for feeding to the conveyor belts.
5. The continuous sampling system, which takes off the belt 60 tons per hour and reduces this to a 5-lb sample.
6. Avoidance of hoppers and use of apron feeders with transfer belts to provide for more uniform belt loading and better operating characteristics.
7. Use of a direct-current variable-voltage system from reclaiming tunnels to shiploader to provide a completely interlocked, variable-speed operation.

Towns are being built at both the port and the mine. In addition to the usual community facilities, three types of houses are being constructed: a row type for general workers, providing 700 sq ft per unit; detached houses for white-collar workers with from 1,045 to 1,285 sq ft of floor area; and staff houses with from 1,400 to 1,630 sq ft of floor area. All were designed by Venezuelan architects, and are of native materials with particular attention to termite resistance. They are concrete block, single-story houses, with concrete floors and a flat concrete roof covered with asphalt felt paper and stone

chips. Windows are native wood jalousies and are screened, and special-type blocks in outside walls immediately under the roof assist in providing through ventilation.

An excellent but somewhat limited water supply for the town at Cerro Bolivar and for mining operations has been developed from a series of natural springs at and near the base of the mountain. This water system was designed by Malcolm Pirnie Engineers, of New York, N. Y. The supply at Puerto Ordaz is from the Orinoco River. It is pumped to a treatment plant where it is coagulated, filtered, chlorinated, and then pumped into the distribution system.

Two Plans for Ore Transportation

Two plans were considered for transporting the ore from Cerro Bolivar to tidewater: one, the construction of a railroad directly north to the Venezuelan coast in the vicinity of Barcelona, and the other, a combination of rail and river route. The former would have required about 275 miles of main-line tracks and the construction of a major bridge across the Orinoco just upstream from Ciudad Bolivar. The bridge would have had to have a total length of about 17,000 ft, the equivalent of bridging a wide reach of the Lower Mississippi. Before reaching the northern coast of Venezuela, the tracks would have had to climb to an elevation of about 1,000 ft to cross the divide before descending to Barcelona.

Comparative costs were estimated on the basis of rather detailed surveys, and the matter was considered by a Venezuelan Commission created to study the two routes. After considering all the factors involved, including the time schedule for construction, initial investment cost, annual costs of operation and maintenance, and the interests of the Venezuelan Government in opening to international commerce the agricultural, commercial, and industrial potentialities of this region of Venezuela, it was determined that the best solution would be the construction of a railroad from Cerro Bolivar to Puerto Ordaz, and the development of a channel in the Orinoco-Macareo to the sea.

The port is located at the confluence of the Orinoco River and the Caroni, one of its major tributaries. The former is one of the great rivers of the world and drains an area of some 378,000 sq miles. Puerto Ordaz is about 160 statute miles above the mouth of the main river, the Boca Grande. About 50 miles below the port, the river begins to discharge to the north and northeast through numerous large distributaries called *caños*, the first of which to leave the main river being the Caño Macareo. Eleven miles down this caño, the Macareo divides into two streams, the more westerly being called the Manamo. The whole delta fronts on the Atlantic Ocean and the Gulf of Paria for a length of about 200 miles, and the area is all subject to overflow during high river stages.

The Boca Grande route was first considered but eliminated because of the bar at the mouth. A dependable deep-draft channel across such a bar, subjected as it is to unfavorable currents and wave action, would require the construction of two jetties each between 16 and 20 miles in length. The cost of such an undertaking would have been prohibitive.

As between the principal distributaries, the Macareo and the Manamo, the former was finally chosen after a preliminary survey by the Gahagan Overseas Construction Co., a dredging concern, which was also engaged to make estimates of costs of dredging and maintaining a ship channel by the Macareo and Manamo routes to tidewater. The report was enthusiastic for the Macareo route and optimistic on the question of maintenance. This report was reviewed at the request of U.S. Steel by the Waterways Experiment Station at Vicksburg, Miss. The Station, while believing that a dredged river improvement was practical, felt that a serious maintenance problem was a definite possibility. It was therefore decided to adopt the Macareo route.

A contract was negotiated in November 1951 with the Gahagan and McWilliams Dredging Companies, as co-venturers, to dredge a channel from Puerto Ordaz to the sea and to provide a 26-ft depth at low tide and a 250-ft width, widening to 400 ft at the mouth, work to be completed by late 1953.

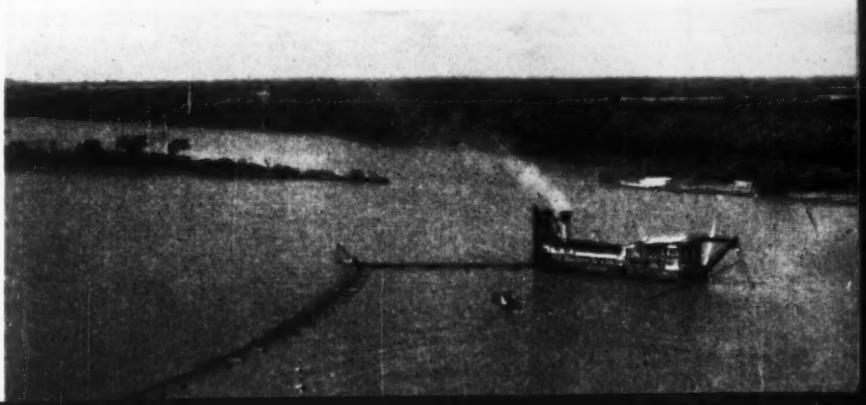
Dredging has been completed to project dimensions, totaling about 33,000,000 cu yd together with some maintenance dredging. This was six months ahead of contract requirements. The preparation of this waterway is explained in detail in Mr. Gahagan's article.

The first vessel to utilize the new route sailed from Puerto Ordaz to the sea on July 17, 1953, and since that date the regular supply vessels of the company have been navigating upstream loaded to 17 ft to train native pilots, to test channel alignment and navigation aids, and to ascertain behavior under traffic.

Construction in the field started in February 1952. Early shipments consisted of construction equipment for rail tracks and highway, and materials for temporary camps and utilities. Manpower employed on the project reached its peak about the middle of 1953, when a total of 7,040 were employed by all parties concerned at the site. Of these, 5,100 were Venezuelans.

The Bechtel International Corp. was engaged from the initiation of the project as managers of construction, and they have supervised and directed all field construction. In addition, they designed and constructed all temporary facilities and have operated all services of supply, including stevedoring, warehousing and transportation. Each contractor furnished his own mess.

Local materials were used to the maximum extent. All cement and petroleum products, and most of the lumber (except ties), tools, and minor supplies were Venezuelan products. Prime contracts were awarded to some 30 Venezuelan firms, and many of these in turn have entered into subcontracts with other Venezuelan contractors.



Dredge Caribbean, here seen in Orinoco River, was one of two dredges which removed 33 million cu yd to open up 178-mile waterway from Puerto Ordaz, through Orinoco and Macareo, to tidewater.

Railroad 90 miles long built at record speed through wild country

GEORGE R. BARLOW, A.M. ASCE

Projects Engineer, South American Operations, Morrison-Knudsen Co., Inc., New York, N.Y.

Granite with a crushing strength of 60,000 psi, flash floods, and a long supply route through wild country were among the barriers surmounted in building the railroad and highway connecting the iron-ore mountain of Cerro Bolivar with the ship-loading port at the confluence of the Orinoco and Caroni rivers—all in less than two years, and ahead of schedule.

A standard-gage railroad, 91.3 miles long, has just been completed to transport the ore to Puerto Ordaz, the port at the junction of the Orinoco and the Caroni, where the ship loading docks are located. A highway 80.7 miles long has also been built. This connects Puerto Ordaz with Ciudad Piar, at the east end of Cerro Bolivar, where the permanent housing development for all personnel connected with the mine is located. (See Fig. 2, page 32.) The railroad will carry only iron ore and heavy supplies. All access and supply for personnel will be by car and truck over the highway.

For the first 43 miles southwest from Puerto Ordaz, the railroad runs parallel to the Caroni River. The highway follows a more direct route to Cerro Bolivar, because the grade limitations for it are naturally less, and therefore the railroad and highway occupy a common right-of-way for only the first 18½ miles, where the country is relatively flat. Natural features of the area traversed by the project divide the work into four parts, each different and presenting its own problems. These areas are as follows:

1. For the first 25 miles (Kms. 0 to 40) out from Puerto Ordaz, the terrain is gently rolling semi-desert, low and hot, with few streams. Vegetation is thick only along the streams; the remainder of the country is covered by dry bush which seldom exceeds 10 ft in height.

2. The next 43 miles (Kms. 40 to 110) presented the most difficult problems. The terrain consists of broken hills, all rock, either bare or with less than 3 ft of earth overburden. There are many streams, all subject to sudden floods. Vegetation is thick along the streams, but the hillsides are relatively open.

3. The next 12 miles (Kms. 110 to 130) is through a savannah area, higher, cooler and agreeable. This area contains millions of acres of rolling grassland which some day will become a rich agricultural section. There are many streams, all bordered by

Difficult access conditions are shown in view of railroad excavation at Km. 135 on side of iron-ore mountain, Cerro Bolivar.

Cut about 25 miles from Puerto Ordaz is seen in air view looking north along railroad right-of-way. Project required about 5,700,000 cu yd of common and borrow excavation and 2,600,000 cu yd of rock excavation. Main headquarters camp is seen in right background.

palm trees. Compared with the low, hot country along the Orinoco, this is a fairyland. Rainfall is quite heavy, and we had to fight muddy subgrade conditions in rail-laying operations in this section. The savannahs—called locally the *Gran Sabana*—run 150 miles southward and are just now being explored to the Brazilian border. The area is also rich in alluvial gold and diamonds.

4. About at Km. 130 (Mile 80.7) the railroad passes Ciudad Piar and starts its 9.3-mile climb up the slope of Cerro Bolivar. The line up the mountain is in a continuous side-hill cut mostly in iron-bearing rock, and the higher portion entirely in iron ore. The lower mountain sides are covered by dense jungle inhabited by many kinds of wild life—monkeys, parrots, tapirs, anteaters, 20-ft anacondas, leopards, and panthers.

The railroad is standard gage and single track, using 132-lb rail with 12 in. of crushed stone ballast beneath the ties. Ties are 7 × 9 nominal size, laid 24 to each 39-ft rail length, and are of creosoted Georgia pine. The railroad was located so that the maximum adverse grade is $\frac{1}{2}$ of 1 percent and the maximum down grade 1 percent, except on the mountain, where the down grade is 3 percent. Sidings, using 100-lb rail, are located about every 12 miles for passing.

The highway is 23 ft wide with a maximum grade of 7 percent and a maximum radius of curvature of 600 ft. No surfacing has been installed as yet. Studies are being made to determine the most effective treatment for the various soil conditions.

Drainage Problem Complex

The problem of providing adequate drainage structures over the entire project was a very serious one and could only be solved by extensive study and experimentation. The area is subject to sudden thunderstorms during eight months of the year, and as much as 6 in. of rain can fall in a localized area in two hours. Normally dry watercourses become raging torrents in a few minutes, with water depths of 10 ft or more.

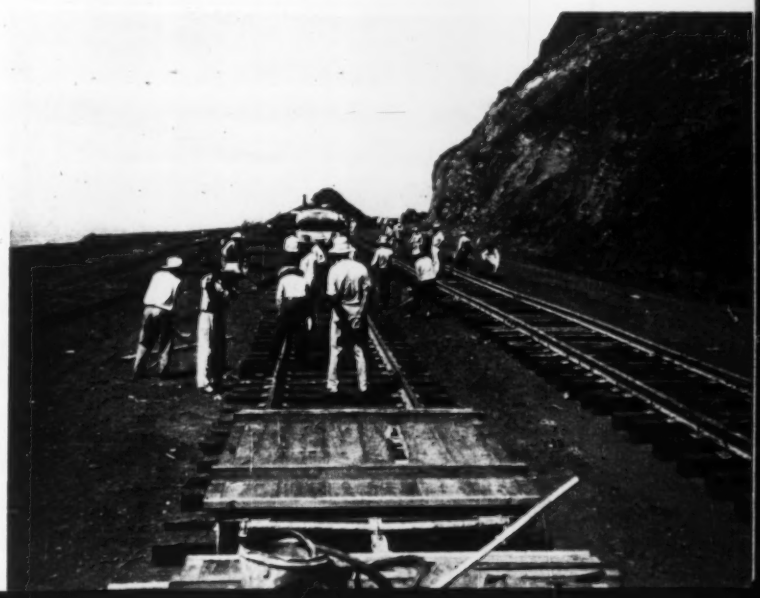
Thirteen multiple-span bridges have been built to cross the larger streams, which are also subject to great fluctuations in flow. The 9 bridges on the railroad consist of twin riveted plate girders, while for the 4 bridges on the highway, five girders are used with a concrete deck. All abutments and piers are concrete.

Along the railroad, 601 separate corrugated culvert structures have been installed, many of them multiple units as large as 120 in. in diameter. Coated corrugated multiplate has been used in all culverts larger than 72 in. Smaller sizes are the coated nestable type, with horizontal joints. The highway has required 338 culvert structures to date, and more will be placed as the need for them is determined.

The area of the project is sparsely populated, and the rights-of-way pass near only four cattle ranches in the entire 90 miles. The area is privately owned and some of the ranches run as large as 250,000 acres. Most ranches are fenced. However, calves are kept near the farm houses until old enough to run with the herd and defend themselves against snakes and leopards.

At the start three points of access to the work were available: the Orinoco River; a gravel state road crossing the line about 20 miles south of Puerto Ordaz and 50 miles east of Ciudad Bolivar; and a trail leading 60 miles southward from Ciudad Bolivar to Cerro Bolivar.

A suitable site for the main camp, on high ground, was selected at Km. 38 (Mile 23.6) near the state road mentioned above. The first equipment was shipped by boat from the United States up the Orinoco River and lightered ashore at Puerto Ordaz. First, an access road was built southward along the railroad right-of-way as fast as possible and a temporary



Single-track railroad has capacity approaching that of double-track line because of long passing tracks and centralized traffic control. Here track skirts edge of Cerro Bolivar near end of line.

camp built at Km. 38. Installation of the floating dock at Puerto Ordaz greatly eased the unloading problems. New equipment was hauled by low-bed truck to the camp, where it was assembled and put in operating condition. Meanwhile, access-road construction was pushed to open up points for starting rock excavation.

A permanent camp was then built at Km. 38 consisting of main office, warehouse, shops, commissary, mess halls, barracks, supervisors' housing, etc. Other camps were installed at Kms. 68, 120, and 145 as required by the work.

The line camps were necessarily of very temporary construction. The barracks consisted of screened corrugated aluminum buildings on concrete floors. Most Venezuelan workmen prefer to sleep in a hammock, so furnishings consisted of 4 × 4-in. posts on 6-ft centers. Staff houses were provided for single supervisors, and 75 house trailers were used for married supervisory personnel. The house trailers, when covered by a sheet aluminum shed, proved to be very satisfactory as they contained all conveniences and could be moved from camp to camp as work progressed.

Venezuela imports a very large amount of its food from North America, and the cost of food is accordingly high. The diet for all employees was very different from that in the States. Camp was provided for 160 foreign technicians or supervisors and 2,700 local employees.

Earth excavation began in March 1952, and rock work late in May 1952. Production averaged about 350,000 cu yd of earth and 160,000 cu yd of rock per month and was 100 percent complete as of October 15. Track laying progressed at the rate of $1\frac{1}{4}$ miles per day, when weather permitted preparation of the subgrade. This year's rainy season was over in September, and main-line track operations were complete so that train operation to the top of the mountain started on November 1.

Excavation Methods Conventional

Earth was moved by tractor and scraper whenever possible. The frequent rains helped the operation in sandy soils throughout the first 25 miles. However, in the clay soil between Kms. 110 and 130 (Miles 68.3 and 80.7), the rain caused a great deal of lost time.

Rock excavation was handled conventionally, that is by wagon drilling, blasting, and loading by $2\frac{1}{2}$-cu yd shovel into end-dump trucks. The cuts were quite narrow and the shovels always had to swing 180 deg. Some cuts were as long as $1\frac{1}{4}$ miles, and this condition required more than the usual amount of equipment to maintain production. Very few side-hill cuts were involved, except on the mountain, because the entire area tends to be rolling or choppy.

The area between Kms. 40 and 110 (Miles 24.8 and 68.3) was by far the most difficult. The rock is a very hard tombstone granite. A piece of it, tested by the University of Pennsylvania Laboratory, was classified as double extra hard granite with a crushing strength of 60,000 psi. In areas where the material was solid, the hardness of the rock made effective blasting difficult and resulted in undue wear and tear on the loading equipment. The problem was even worse in areas where the same rock was encountered as nested piles of boulders. Here blasting was not very effective because the explosive force was dissipated through the clay fill and the boulders were hardly disturbed.

This is the area of many streams subject to flash floods, and it cost over a half million dollars just to maintain the service road for one year. When the crews went to work they never knew when they would get home. At one time, as a result of floods, a crew of 10 men was marooned for 7 days, and food had to be dropped to them from an airplane. On another occasion, a crew sent out to rescue a truck driver, found him sitting on top of his inundated truck with alligators snapping at his trousers. On the return trip, in another valley, the power wagon was upset by a sudden wave of water in a normally dry stream and three men were drowned. These are examples of the difficult working conditions encountered.

The camp for the work on the ore mountain, Cerro Bolivar, is located on the very top. From here it is possible to see for 100 miles in any direction on a clear day, and Auyantepui, site of the highest waterfall yet discovered, can be glimpsed on the horizon. As previously stated, the construction of the railroad on the mountain is practically all in side-hill cut. A marshaling yard containing 200,000 cu yd of iron-ore fill was built with part of the excavated material.

The ore is hardest on the surface. This made access roads difficult to build, especially in places where the side slopes of the mountain approach 45 deg. Wagon drills, arranged to drill horizontally, were pushed ahead to break open a road over which the blast-hole machines could be worked. After the crust had been removed, the material was softer in places. However, stringers of iron-bearing quartzite and lenzes of hard ore made it necessary to blast all the material moved. Weather did not hamper operations on the mountain to the extent that it did lower down because the porosity of the material allowed water to drain away rapidly.

Rail and Ties Stockpiled at Puerto Ordaz

The rail and ties were transported by ship and stockpiled at Puerto Ordaz. Each day's requirement was loaded onto flat cars by truck crane and transported to the railhead by diesel locomotive. Ties and fittings were transferred to a truck at a convenient location near the railhead and spread directly on the subgrade as required. Rail was brought to the railhead behind a track-mounted crane, which places the rails on the previously arranged ties. Rails were set by gage and by plastic spacer to proper location, and enough spikes were driven to hold them until the

Major equipment used on railroad and highway

Excavation

14	$2\frac{1}{2}$-cu yd shovels
2	$1\frac{1}{2}$-cu yd shovels
3	15-ton truck cranes
64	12-cu yd end-dump trucks
6	6-cu yd end-dump trucks
45	tractors and bulldozers
15	scrapers
18	self-powered scrapers
40	compressors
7	motor patrols
45	wagon drills
2	5-in. blast-hole drills
160	pieces of transportation equipment

Track work

One ballast plant consisting of

1	60 × 48 in. primary jaw crusher
1	60 × 144-in. apron feeder
2	15-in. gyratory breakers as secondary crushers
2	7-in. gyratory crushers as terciaries
4	5 × 12-ft vibrating screens
4	diesel generators
1	stacking conveyor to provide 100,000-ton product storage
1	recovery tunnel conveyor for direct loading of cars at rate of 400 tons per hour
2	power ballast tampers
1	self-powered crane for laying rail
20	standard 70-ton flat cars
40	50-cu yd ballast cars
2	mobile cranes
10	pieces of transportation equipment
3	rail-mounted compressors for driving air tools

Major quantities involved

Common and borrow excavation	5,700,000 cu yd
Rock excavation	2,600,000 cu yd
Structural steel	2,000,000 lb
Culvert pipe	4,500,000 lb
Ballast for track	500,000 tons

arrival of the driving gang which followed close behind.

Ballast placement was kept within a two-day run of the railhead. After considerable experimentation, a special plow was devised which allows enough ballast to be dumped so that a 9-in. raise can be made in one lift. The final 3-in. raise is being made after all the rail is in place. Raising was accomplished in the usual manner with track jacks and two power vibrating tampers, working in tandem, each tamping alternate ties.

At Km. 45 (Mile 28), a huge black rock dome was noticed alongside the railroad, one of the most noticeable landmarks in the entire area. The rock in it is the same tombstone granite previously described. This dome is about 300 ft high and covers an area of $^1/_2$ sq mile, and was the natural location for a quarry from which to produce the crushed-stone ballast required for the railroad.

When scouting the area, a rock ridge 50 ft high was found about 1,500 ft east of the dome across a jungle-filled flat. The rock ridge is flat on top and tapers at one end so that trucks can easily drive along the crest. The jungle was cleared and the crushing plant oriented at right angles to the railroad, with the primary crusher set in a niche carved in the rock ridge. This location of the primary crusher assured a good haul road in all weather and made it unnecessary to construct a ramp or headwall at the crusher.

The trucks dumped into an apron feeder which fed the 48 × 60-in. jaw crusher. The rock, broken to minus 8 in., was conveyed to a surge pile before entering the sizing plant. Rock was taken from the surge pile by a plate feeder in a recovery tunnel and conveyed to the top of the screening plant, where it was divided and sent over two scalping screens. These screens carried 5-in. mesh on the top deck and $2^1/_2$-in. on the lower. Oversize from the 5-in. screen went to the secondary crushers; oversize from the $2^1/_2$-in. screen, to the terciary crushers. Material passing the $2^1/_2$-in. screens fell onto two more vibrating screens below. These carried $^3/_4$-in. wire mesh on the top deck and $^1/_4$-in. on the lower deck. Oversize from the $^1/_4$-in. screen was salvaged from the waste for use as concrete aggregate and road surfacing material. Fines, passing through the $^1/_4$-in. screen, were waste and were conveyed to a storage pile.

Production of the ballast plant averaged about 2,000 tons a day of finished product, or 3,500 tons of quarry run. The operation was continually hampered by the hardness of the rock. The capacity of the primary crusher was about two-thirds of what it should be, and the wear and tear on crusher jaw and toggles was excessive.

The quarry was first shot by the coyote-hole method of driving small T-shaped tunnels into the rock and blasting with 60,000 lb of dynamite, or about 1 lb of dynamite per cu m (about $^3/_4$ lb per cu yd) of overlying rock.

This method did not produce the desired results in the hard rock, because the dome is without seams or weather cracks and tends to peel like an onion. The coyote-hole blasting resulted in huge slabs which required an excessive amount of secondary blasting and unusual wear on the loading equipment. Later blasting was done by wagon drills on close spacing from benches, and fragmentation was much better. The quality of rock produced was excellent and no trouble was experienced in meeting the AREA specifications for gradation.

Construction of the Orinoco Railroad and Highway has been a challenging job. Conditions have seldom been as anticipated. Excavation quantities have overrun 100 percent. Weather, supply, labor and the rock encountered have all been difficult. In view of these problems, the construction of 90 miles of railroad and 80 miles of highway in less than two years, and in several months less than the scheduled time, is something of a record.

Railroad bridges consist of twin riveted plate girders, whereas highway bridges have five girders with concrete deck. All bridge abutments and piers are concrete.

Completed rail line has total 12-in. depth of ballast in place. Special plow was devised to allow 9-in. raise to be made in one lift. Final 3-in. raise was placed after all rail was in place.

WALTER H. GAHAGAN

Gahagen Overseas Construction Co., Inc., New York, N.Y.

Memorable dredging operation opens Orinoco-Macareo Waterway

The necessity of establishing the contractor's own communication and transportation lines 237 miles long, from Ciudad Bolivar to the mouth of the Macareo; the isolation of employees for months at a time on dredges in the jungle; transportation of personnel, food, and dredging supplies thousands of miles by ship, truck, plane, and boat—all these combined to make the dredging of the Orinoco-Macareo Waterway in Venezuela unique in dredging history. The project provided for the dredging of a channel 178 miles long in the Orinoco and Macareo to a minimum depth of 26 ft and a width of 250 to 400 ft. (All depth references are to low river stage.) It also included the dredging of an inland harbor at Puerto Ordaz to a depth of 30 ft, the dredged material to be used to provide over 2 million cu yd of land fill as well as aggregate for concrete.

Three possible routes through the Orinoco delta were considered—the Boca Grande, the Manamo, and the Macareo. (See map, Fig. 2, in Mr. Wanamaker's article, page 32.)

Why Choose the Macareo?

The question most frequently asked in Venezuela is, why was the Caño Macareo chosen for development in preference to the Boca Grande or the Manamo? To answer this question it is necessary to go back to 1948, when the Gahagan Overseas Construction Co. was given the mission by the Oliver Iron Mining Co., a subsidiary of the U. S. Steel Corp., of determining the feasibility of dredging a channel in the Orinoco. United States Steel wanted the answer as soon as possible and therefore a thorough engineering investigation could not be made. Every short-cut had to be utilized. Up to the time of this survey, it was generally considered that there were only two feasible ways to enter the Orinoco—through the Boca Grande and through the Manamo. The draft of all ships was limited to about 15 ft over the bars at the mouths of these routes at high tide, and the bar at La Pastora limited traffic on the Manamo during the low-water season to vessels drawing no more than 8 or 9 ft.

Although it now appears that the greatest problem in maintaining the Orinoco-Macareo route will be at the Pastora and Franquia bars (Fig. 1), the problem originally uppermost in everyone's mind was the possibility of

Material dredged from Franquia Bar has been deposited in closure dike in foreground of aerial view. At bend in Macareo at left, dredge *Peru* can be seen with LST *Americas* and barge *Casa Blanca* used for labor quarters (resembling floating house).

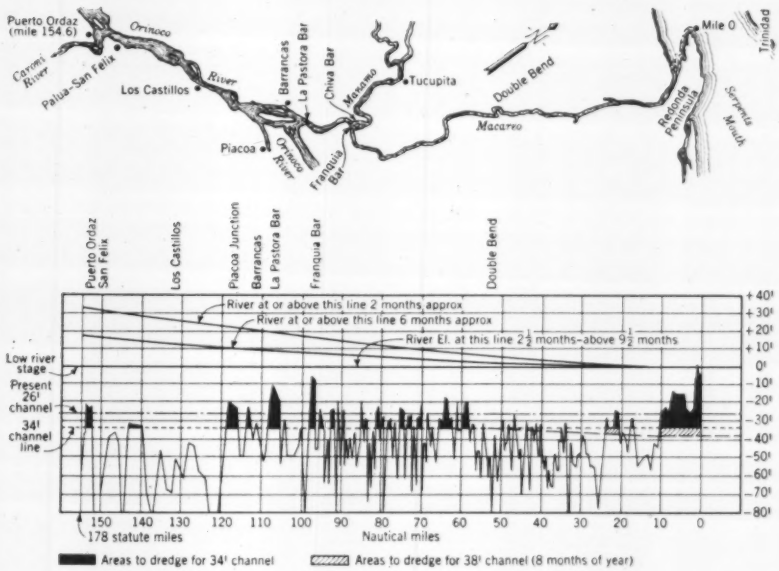


FIG. 1. Orinoco-Macareo Waterway has total length of 178 statute miles, of which 32 required dredging to secure 26-ft minimum depth and width of 250 to 400 ft, at low river stage. Total material removed was 33 million cu yd.

keeping the mouth of any route open to the sea. With this in mind, Folke Kihlstedt, resident engineer in charge of U. S. Steel's iron-ore explorations, in a casual conversation with officials of the Gahagan organization, mentioned that he had noticed the deep-water contour was closer to the shore along the Redonda Peninsula than elsewhere along the Orinoco delta. This comment showed the way to open up the Orinoco to deep-draft vessels.

With the exception of a daily record of river stages maintained at Ciudad Bolivar since 1934, at Palua since 1941, and at Tucupita on the Manamo during intermittent periods, no engineering information was available regarding these rivers. Fortunately, aerial photographs had been taken of the Orinoco itself from which a working map could be made from Ciudad Bolivar to Pastora Bar. However, for the Macareo, it was necessary to construct a most inaccurate, makeshift line map pantographed from a composite aerial photograph of the entire Amacuro Delta.

In 26 days, between September 7 and October 3, 1948, Gahagan's engineers, using the U. S. Steel Corp.'s launch *Spindle*, with a Bludworth echo sounder installed, sounded the center line and cross-sectioned 336 miles of river, on the Orinoco, the Macareo, and the Manamo. On the Orinoco, cross-sections were run at average intervals of two miles and at much closer intervals wherever the soundings indicated that dredging might be necessary to secure a 34-ft channel at low water.

On the Macareo, cross-sections were taken at an average interval of 2,000 ft over its entire length, to the tip of the Redonda Peninsula. Similarly, cross-sections were made over the entire length of the Manamo at 3,000-ft intervals and continued out to deep water in the Gulf of Paria. The surveys on the Orinoco and Manamo were plotted on line maps. All cross-sections were plotted on cross-section paper and dredging quantities computed.

Dredging quantities were found to be much greater on the Manamo than on the Macareo. Other considerations against the Manamo route were the difficulty of maintaining a channel 9 miles long through the sand bar at its mouth, exposed to the open sea, and the two extensive bars found on the Manamo itself. The Boca Grande, although the largest mouth of the Orinoco, was ruled out because the bar at its mouth is 20 miles wide, and exposed to Atlantic storms.

The preliminary report, submitted on November 5, 1948, affirmed the Gahagan organization's belief in the overall feasibility of the Macareo route. The impossibility of doing a thorough engineering job without any accurate basic maps, shore control points, or any accurate way of locating the position of the sounding launch is too evident to need comment. Notwithstanding, the rough estimates did provide a sound basis for the selection of the most favorable route, which subsequent thorough mapping and dredging verified.

The second phase of the field investigation was the determination of the character of river-bed materials. Probings were made the whole length of the Orinoco-Macareo Waterway as well as across all suggested cutoffs. Wash samples were recovered wherever possible and representative materials sent to the Pittsburgh Testing Laboratory for analysis, as the abrasiveness of the material is a most important factor in the cost of dredging because of wear on pumps and pipelines.

Probings were taken with a tug equipped with an A-frame and winch for handling casing, jetting pipe, and driving hammer. This tugboat was accompanied by a small houseboat on which the men lived. Because of the lack of anything to do during off time, and the loneliness of the jungle, all the men asked to be allowed to work seven days a week and the longest hours daylight permitted. Experience obtained during this grueling job led to the successful planning of the later dredging work and a full appreciation of the problems to be met.

The investigation disclosed that the Macareo, commencing about five miles downstream from Barrancas, is actually the main branch and second only to the Boca Grande as an artery of discharge in the delta system. Only two shallow bars are contained within its length, the first at Pastora, where it leaves the main Orinoco, and the second at Franquia, where the Manamo leaves the Macareo. From Pastora to the junction with the Manamo, the Macareo has a well-defined channel with an average depth of about 40 ft. Unlike the Manamo, it contains no shallow bars for its whole length below its junction with the Manamo. The channel is well defined, with a remarkably consistent width averaging from 1,200 to

Dredge *Peru* has 30-in. discharge, and 4,000 hp on main pump. View with ladder raised shows cutterhead.

1,800 ft for 80 miles. With the exception of the Double Bend, which contains deep water, it is remarkably straight, widening to a low-water width of 2,600 ft at its mouth. The bar at the mouth exposed to the sea is only about 3 miles across. Within a half mile of the 40-ft contour outside the Serpent's Mouth there is about 150 ft of water with strong favorable currents to the west.

The river gradient from Puerto Ordaz downstream is exceedingly flat, approximately 25 ft in 170 miles. For 126 miles from its mouth, the overall gradient of the Macareo is almost horizontal. Tidal effects raise the level a maximum of 39 ft at Puerto Ordaz and 27 ft at the Franquia Bar. High and low river stages occur very regularly, the annual low coming in late March and the annual high in August.

A perplexing question was, why had not the Macareo been used previously, as the preferred entrance to the Orinoco from Trinidad? Research brought to light the fact that originally the Macareo was the preferred route. Evidently, with the establishment of the Creole Petroleum oil camp at Pedernales at the mouth of the Manamo, ship traffic had switched to that route, as the buoys and lights installed at Pedernales made it possible to enter the Manamo at night. Also, the oil camp at Tucupita, 80 miles up the Manamo, attracted trading and cargo vessels. On the Macareo there was no settlement to attract traffic.

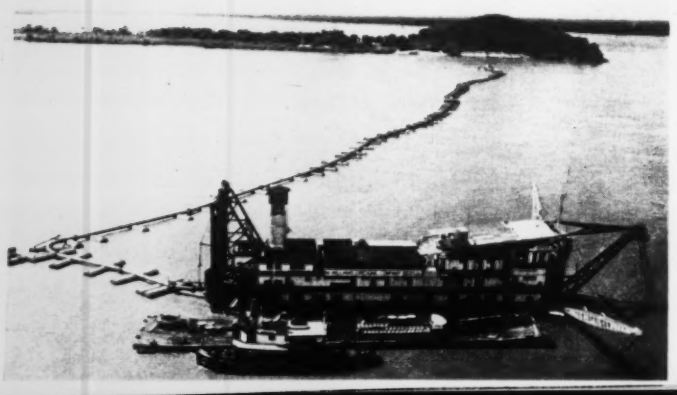
On June 20, 1949, the final report of the Gahagan Overseas Construction Co. was submitted to the Oliver Iron Mining Co. The report concluded that it was feasible to dredge and maintain a deep water channel through the Orinoco-Macareo route. On November 28, 1951, three years after the commencement of the investigation, a dredging contract was awarded by the Orinoco Mining Co. to the Gahagan Overseas Construction Co. of New York and the McWilliams Dredging Overseas Corp. of New Orleans, as joint venturers, after bids had been taken from six major dredging companies. The contract provided that the first dredge must commence work in 90 days and the second 60 days after the first. Eighteen months was stipulated for the completion of about 30 million cu yd of river dredging, and 165 days was set as the time for completing the important harbor dredging at Puerto Ordaz.

Dredging consisted of the removal of some 33,000,000 cu yd of sand, gravel, clay, mud and on one section rock, all in the 32 miles of the river which required dredging. These 32 miles were spread over the full 178 miles from Puerto Ordaz to the mouth.

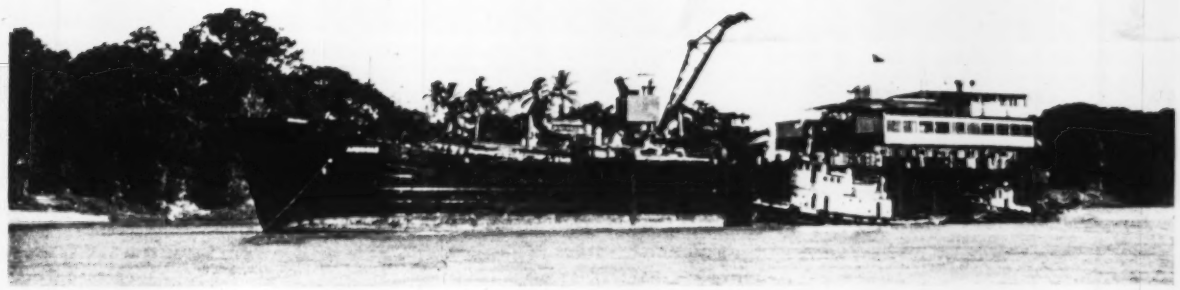
Material dredged from the Orinoco was discharged about 2,000 ft from the center line of the channel. At the Pastora and Franquia bars, the excavated material was used to make closure and training dikes. In the Macareo the materials were pumped overbank and into secondary channels. At the mouth, the material was pumped generally to the north and west of the channel, in the direction of the prevailing currents.

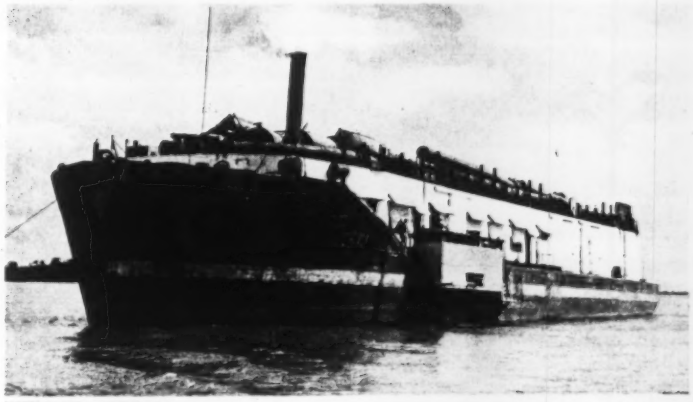
The dredging plant and equipment mobilized on this project were headed by the dredge *Peru* of 30-in. discharge with 4,000 hp on the main pump, and the dredge *Caribbean* of 28-in. discharge with 5,000 hp on the main pump. The two dredging units have been likened to floating towns moving down the river. In addition to the two dredges, a 327-ft LST (used as living and storage quarters for the dredge *Peru*) and a 275-ft YF with machine shops and living quarters, the fleet included about 35 auxiliary units including a refrigerated ship, seven tugs, four derrick barges, two houseboats, eight flat barges for both oil and material and pipe transportation, four large launches, D-7 tractors, automobiles and trucks, numerous small craft, about a mile of floating pontoon pipe, and about three miles of shore pipe. This equipment represented a replacement value of approximately 9 million dollars.

The Orinoco Mining Co. desired to obtain as much experience as possible on the behavior of the critical sections and navigational problems before actual use of the waterway by ore carriers. Accordingly, it was decided that, after the dredging of the harbor at Puerto Ordaz, the next projects in order would be the removal of the bars at Franquia and Pastora and then the opening of the mouth into the Gulf of Paria, considered the most hazardous part of the work. Both dredges and their many pieces of attendant plant then had to be towed almost all the way back to Puerto Ordaz, whence they worked their way down the river. This order of work



Dredge *Caribbean* of McWilliams Dredging Overseas Corp., which has 28-in. discharge with 5,000 hp on main pump, is seen working in Orinoco River at Palua. Performance of this dredge was responsible for completion of harbor at Puerto Ordaz three months ahead of schedule. Over 2 million cu yd was dredged there in 1 1/2 months.





LST *Americas*, above, was used for staff housing, supply storage, and cargo carrier for dredge *Peru*. It is seen anchored in the Macareo with tugboat and dredge tender alongside. McWilliams' 275-ft YF transportation barge, right, was used for machine shops and labor quarters. Lower right, refrigerated vessel delivers food to labor-quarters barge *Casa Blanca*. In addition to two dredges and these large units, dredge fleets included 7 tugs; 4 derrick barges; 8 flat barges for oil, material, and pipe transportation; 4 large launches; numerous small craft; about a mile of floating pontoon pipe and three miles of shore pipe.

meant that all equipment, attendant plant, and disassembled pontoon line had to traverse the river four times for a combined distance of almost 800 miles.

Six Months Ahead of Schedule

Completion of the harbor at Puerto Ordaz more than three months ahead of schedule, because of the outstanding performance of the McWilliams dredge *Caribbean*, gave the Orinoco Mining Co. the opportunity to construct its docks and terminal facilities well ahead of schedule and to accelerate its whole construction program. Completion of all the dredging work under the original contract six months ahead of schedule decreased its overall cost, as the contract provided for a sliding scale of pay for each cubic yard dredged, based on actual production. This sharing with the Orinoco Mining Co. of the benefits of increased efficiency created a three-way partnership which had most beneficial results to all. It encouraged teamwork throughout the job not only between the joint venturers but between them and the Orinoco Mining Co.'s engineers. This teamwork and the attitude of the Orinoco Mining Co.'s engineers were factors in the production record obtained.

Other reasons for the success of this project, in both cost and time, were first, proper and thorough advance planning; second, the character and devotion to their work of the experienced dredge personnel; and third, the quality of the equipment used. Good fortune and good weather, so necessary to the success of any construction venture, were in this case in the contractor's favor.

Operational Difficulties Overcome

The long isolation created severe problems for the men. Although they were carefully selected, out of every ten from the United States, four returned without completing their contracts, the reasons ranging from actual sickness to a simple inability to combat the loneliness and difficult working conditions.

Sting-rays and electric eels as well as the dangerous flesh-eating fish found in the river contributed less to the difficulties of the crews than the mosquitos and other annoying insects which were so small that even the fine screens could not keep them out. The lights on dredges, tugboats, and derricks, as well as those in the living quarters, were beacons attracting insects of every imaginable character. The intermittent showers and rains of cloudburst proportions combined with the steaming heat of the jungle to cause an unusual amount of respiratory troubles which resembled virus attacks. Fungus growths attacked ears as well as other parts of the body.

Bulldozers seldom could be used because of softness of banks, so hand labor had to roll in 16-ft lengths of 30-in. shore pipe, weighing over 1,500 lb each. Note crew clearing right-of-way in background. Rainy season floods all delta region, bringing waist-high water and knee-deep mud.

Of course complete medical facilities, including the services of a competent physician, were maintained on each dredge. Moving pictures were run five or six times a week and such games as were appropriate aboard ship were furnished the men, as well as magazines, newspapers and books. Attendance at the movies by all personnel off shift attested to the need felt for diversion which would break the monotony of isolation.

High monetary incentives were necessary because the foreign service worker in each category had to be superior to his counterpart working in the United States. Not only was a higher degree of technical ability required in this remote location where there were no specialists to call in, but also a much higher degree of emotional stability.

The problem of supply and repair was also paramount. Full-scale machine shops were part of the equipment of each dredge unit, as well as high-grade machinists and welders whose ingenuity kept the plant going on many occasions until replacement parts could be received from the United States. At least 45 days' advance notice was required by the Orinoco Mining Co. to clear the *lista previas* or customs papers necessary to secure freedom from duties. This meant that it took two months or more to get supplies.

In all, 35 different items of specialized plant and equipment weighing 14,500 tons had to be mobilized. In addition, 4,350,000 lb of materials and supplies other than food were shipped by boat and plane from the United States.

All personnel, including inspectors of the Orinoco Mining Co. and the government, were housed and fed by the contractor—over 320 persons. The transportation of food in edible condition over difficult supply lines, 237 miles long from Ciudad Bolivar, presented one of the most trying problems. Although quantities of canned goods, over 300,000 lb, were imported from the United States, it was necessary to procure locally all fresh vegetables, fruits, fresh meats, and frozen foods. It became necessary to charter a refrigerated ship to transport food to the further reaches of the job. In spite of these problems the costs of feeding the men were comparable to those at the large oil camps, which run over $3.00 a meal. Costs of $6.00 a meal and higher for staff meals in jungle camps in geophysical operations in Venezuela are reported as not unusual.

Operational difficulties were also great. Since the jungle extends to the very edge of the high banks on the Macareo, it was necessary to clear the dense growth so that the dredged material could be pumped over the bank and onto the lower land beyond. Bulldozers seldom could be used because of the softness of the terrain. It was a common sight to see even the captain and deck captain of the dredge leading the dump foreman, mates and laborers into the slimy jungle to insure that the dredge landing would be set up on time.

Dredging Difficulties Many

High water not only made the work for the men more difficult, but increased dredging difficulties. At times the dredge had to work on the longest extension of its spuds and dig with the ladder lowered to its maximum depth. At times it was necessary to cut away a bank at the river's edge while the stern of the dredge was in 90 ft of water, which made the use of the spuds impossible, and improvisation was again required. At the mouth of the Macareo it was necessary to use heavier anchors and these in greater numbers than normally, since ordinary anchors would not hold the dredge and pipeline in the strong currents and heavy seas. Even the larger anchors often dragged and had to be reset.

In the open sea in the Gulf of Paria, heavy seas sometimes forced the dredge to stop digging entirely. At such times water was continually pumped through the pontoon lines to maintain the pressure necessary to hold them together. Notwithstanding this precaution, on many occasions the line broke and presented the almost insurmountable problem of reassembly under high wave conditions. The possibility was ever present that the whole pipeline might be lost in a storm in the Gulf of Paria.

As the material at the mouth of the river was very soft, the spuds would not hold with normal penetration and had to be held with the brake. This difficulty was overcome by rigging up stern anchors.

Difficult dredging was encountered both in the harbor area at Puerto Ordaz and in the reach near Barrancas. In the harbor area, rock and boulders encountered near the project depth were cleared of overburden by the dredge *Caribbean* sweeping with the cutter removed and with bars welded across the suction openings. In the Barrancas area, a ferruginous sandstone was encountered for a stretch of about 4,000 ft. The dredge *Peru* installed rock cutters and succeeded in dredging the sandstone without resorting to drilling and blasting. Aside from the normal changing of rock cutters and repointing of teeth, several cutterhead shafts of 11-in. diameter were broken as well as one equally large cutter-line shaft. One new shaft lasted 20 minutes after installation.

Supplies of every nature had to be guarded at all times regardless of their usefulness, as the jungle natives had never had the opportunity to learn responsibility and the rules of private ownership. At times all the lanterns were seen to move in unison off the pontoon lines and disappear into the blackness of the night. Levermen often found themselves staring perplexed into the dark jungle where their range lights had been a moment before. At such times, the Sperry gyroscope compass with which each dredge was equipped, was used. This compass was also used during the terrific tropical downpours which obscured vision for long periods.

One question is uppermost in everyone's mind. What will be the maintenance of this huge waterway? The answer is that it is too early to tell. It is known that the banks at the mouth of the Macareo are standing up remarkably well, and that shoaling in this section from which about 8 million cu yd was dredged about a year ago, is not alarming. At both La Pastora and Franquia, training dikes and revetments are being constructed, which it is thought will have considerable effect in keeping the channel open. The river itself is supplying the testing ground and the tests thus far give reason for optimism.

The photographs in this article are used by courtesy of Herbert Brooks Walker.

L. O. MILLARD

Assistant General Sales Manager, Link-Belt Company, Chicago, Ill.

Conveyors handle 6,000 tons of ore per hour at Puerto Ordaz

The ore-handling system at Puerto Ordaz serves a most important function in the Orinoco Mining Co.'s overall plans for delivering iron ore from Cerro Bolivar. Essentially, it is a transfer station for unloading run-of-pit ore from mine cars, crushing it, and storing it on the ground, whence it is reclaimed and loaded into ocean-going ships as needed. The remote location of the plant and the magnitude and importance of the entire operation emphasized the necessity for equipment that would be dependable and economical to operate. Although the flow sheet is relatively simple, the high capacity and the different characteristics of the ore precluded direct comparison with existing installations as an aid in solving the most intriguing and challenging problems.

In the part of the system for unloading, crushing, and bedding the ore into storage, all components are designed to handle as much as 6,000 gross tons per hour (gtph) to meet the ultimate requirements of mining and shipping. However, as only one secondary crusher is being installed at this time, the dumping cycle and apron feeder are adjusted to provide a capacity of 3,000 gtph for the present.

The design of the reclaiming and shiploading portion of the system is influenced by future needs as well as physical and climatic conditions. Early shipments will be made largely in Liberty, Victory and other small ocean vessels. Special carriers of perhaps 40,000 to 50,000-ton capacity are anticipated for shipping in the future. In order to dispatch these ships quickly and economically, the design provides ultimately for the installation of a duplicate shiploader and conveyor lines to load at peak rates of 12,000 gtph. The initial installation, however, includes only one loader with its conveyor line from the reclaiming tunnels.

Extensive tests by drilling and tunneling indicated the equipment had to be capable of handling ore which occasionally might tend to pack and bridge over openings like clay, a characteristic referred to here as "sticky." Behavior of the ore had to be carefully considered throughout every stage. It was particularly important in assuring a uniform flow at the unprecedented rate of 6,000 gtph through hoppers, chutes, and transfers between conveyors. Each of these points could be a potential source of havoc resulting from a build-up or packing of sticky ore when handled at nearly 2 tons per sec. Also, the impact and destructive sand-blast effect of hard, sharp material as discharged from high-speed belt conveyors were major design considerations.

Dumps 67 Cars per Hour

Ore from the mine is received at Puerto Ordaz in cars having a capacity of 90 gross tons each. Cars are uncoupled from the train and drifted one by one into a conventional retarder, where each is held until withdrawn by a barney haul. The loaded cars are fed into a single-car rotary dumper and discharged at the rate of 67 per hour. The loaded car bumps the preceding empty from the dumper and is stopped by track brakes in the dumper. The empty runs by gravity through a kick-back to a collecting track. See Fig. 1.

All functions of the barney and dumper are electrically interlocked and controlled by one operator, stationed so that he can see the incoming and outgoing cars as well as the stone box above the primary crusher. Although the dumping cycle is much faster than that for any existing dumper of this size, a careful study indicated that it is safe and practical, both mechanically and electrically. Also, for a reasonably intelligent and experienced operator, the cycle does not present any unusual problems of dexterity or fatigue.

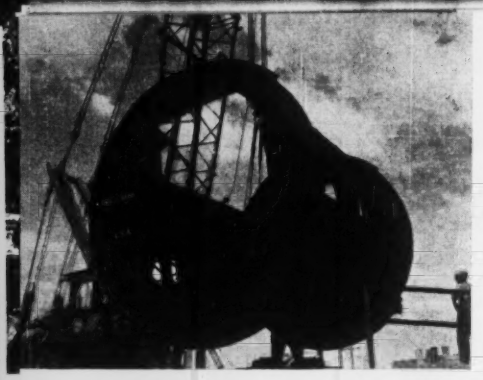
From the cars, ore is discharged to a scalping grizzly set with 9-in. openings (Fig. 1). The oversize flows to a stone box above a 60-in. heavy-duty, open-bottom, gyratory crusher. Undersize from the grizzly joins the minus 9-in. crushed product beneath the crusher, where there is space for about $2\frac{1}{2}$ carloads. This volume provides surge for a uniform feed to the conveying system, and the resulting headroom assists in protecting the crusher eccentric.

The use of one 60-in. primary crusher for an unloading capacity of 6,000 tons per hour is based on a crusher capacity of 3,000 tons per hour. Tests indicated that only rarely will more than 50 percent of the ore pass over the grizzly. Obviously, with more than 50 percent oversize, the crusher will limit the capacity that can be fed to the system.

One feeder is used to withdraw the combined grizzly undersize and the crushed product from a large common outlet. This arrangement provides the means for a uniform feed to the conveyor system, regardless of the wide fluctuations known to exist in the size consist of the dumped ore. Furthermore, mixing the crushed product with such sticky ore as may pass through the grizzly should promote flowability and reduce the tendency to bridge over the feed opening.

The feeder itself is of the steel-apron, pan type, of extremely massive construction, designed to withstand the punishment expected at this location. To protect the crusher eccentric in case the apron feeder is stopped, rotation of the dumper will be halted automatically and a warning flashed to the dumper operator, but the crusher will continue to operate.

A system of belt conveyors 60 in. wide is used to handle ore from the primary crushing station to the sec-



Main section of rotary car dumper is hoisted into place. Dumping cycle is much faster than for any existing dumper of this size.

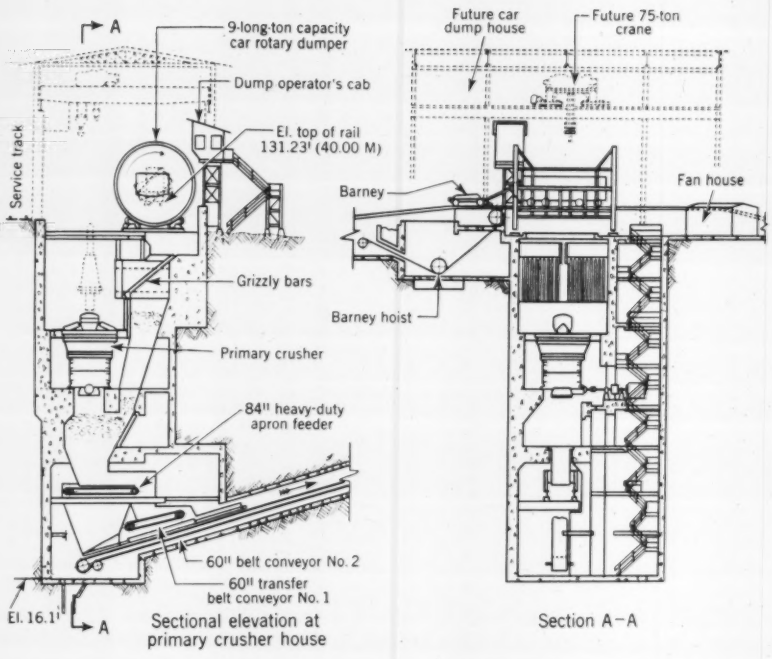


FIG. 1. Rotary dumper dumps 67 cars per hour to primary crusher. Feed from crusher to conveyor system is at 6,000 gross tons per hour.

ondary, and then on to storage at a rate of about 600 ft per min. The main inclined conveyor No. 2 from the primary crusher to the secondary crusher is equipped with a steel-cord belt and is driven by a 1,250-hp motor. To reduce wear on this expensive belt, a special transfer conveyor was installed beneath the apron feeder. Also, components of the system are protected against damage from tramp iron by a metal detector located near the foot end of conveyor No. 2. Both these safety devices will be described later.

At the secondary crushing plant (Fig. 2), the minus 9-in. ore is discharged from conveyor No. 2 into a surge and distribution chute from which it is fed uniformly by manganese apron feeders to each of the four scalping screens ahead of the crushers. For more effective crushing results, oversize from these screens is delivered to opposite sides of the crusher stone boxes. Space is provided between the screens for a shuttle belt to be installed in future, on which coarse ore may be withdrawn from the top decks of any or all of the screens.

The secondary crushing plant is designed to produce a final product, of which 85 percent will pass between bars spaced at 5-in. clear openings. Maximum capacity is based on not more than 40 percent of plus 5-in. material passing to the two 30-in. by 70-in. crushers. The latter are of the gyratory type, specially designed for secondary service.

Space limitations and topography determined the location of the conveyors from secondary crushing to storage, as well as the use of a bridge for bedding the ore. The purpose of the ground storage is to provide an adequate, immediately available sup-

At secondary crusher, here seen under construction, minus 9-in. ore is fed to four scalping screens ahead of crushers, which produce final product of which 85 percent will pass between bars spaced to provide 5-in. clear openings.

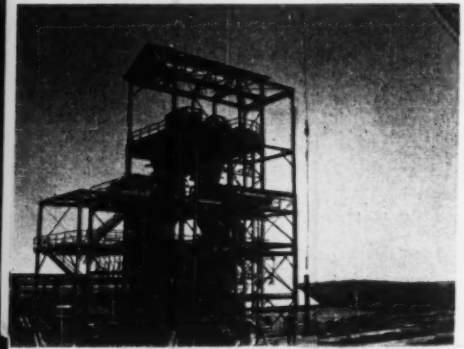
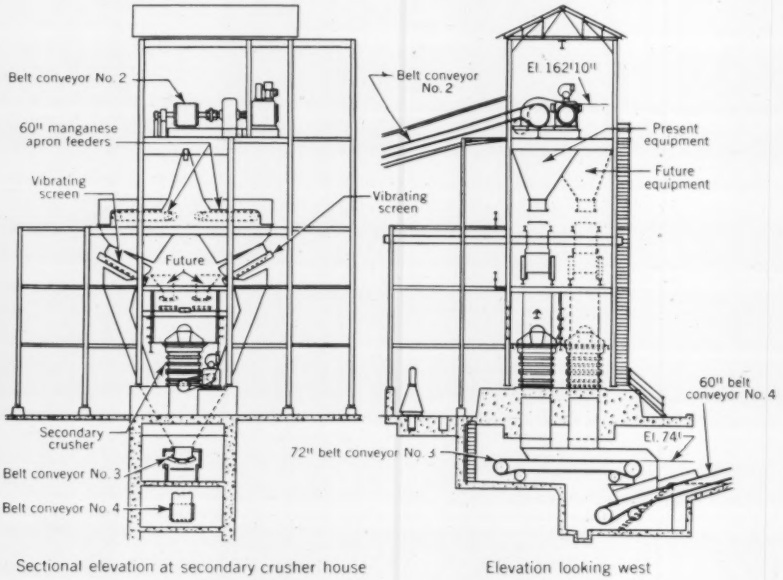
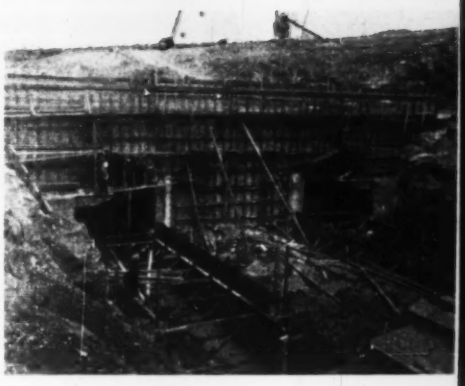


FIG. 2. At secondary crusher, oversize from scalping screens is delivered to opposite sides of stone boxes, or lump ore may be withdrawn by future shuttle conveyor.



Ore-handling system at Puerto Ordaz, to be placed in operation early in 1954, must be dependable and economical to operate. Rotary car dumper and primary crusher are at right, then secondary crusher, and storage pile and ore bridge in center. Sampling and weighing station and control house are in left foreground, and travelng boat loader is on dock.



ply of ore for loading ships as well as a surge between mine production and shipping. Some blending will occur from bedding and reclaiming the ore, but the system is not intended primarily for that purpose.

The available area for the 700,000-

Ore will be reclaimed from storage by two tunnel conveyors, here seen under construction. From the two 48-in.-wide tunnel belts, loaded by rotary-plow feeders, ore is transported on system of 60-in.-wide belt conveyors to traveling shiploader on dock.

FIG. 3. Ore is withdrawn from continuous shelf beneath storage pile to tunnel belt by special traveling rotary-plow feeder.

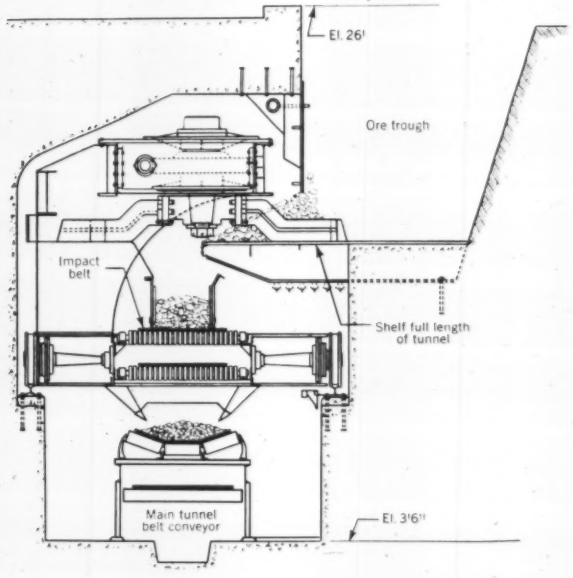
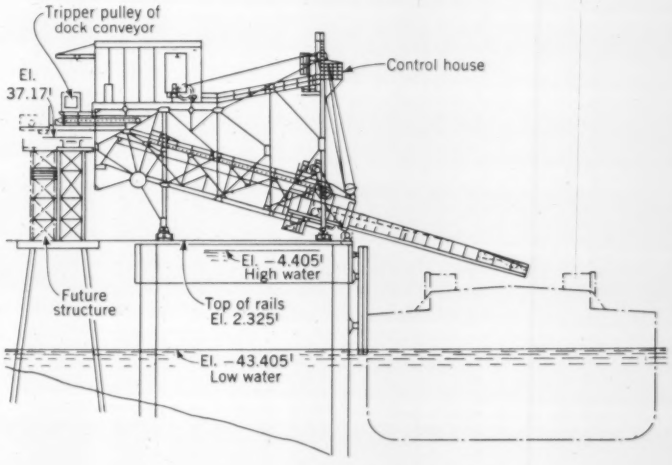


FIG. 4. Traveling shiploader can serve vessels of up to 50,000-ton capacity and compensate for 40-ft variation in river level. Provision is made for second loader to be fed by a second belt-conveyor line from tunnel belts.



ton initial pile was relatively narrow. Also, it was too short to contain the proposed future tonnages in a multiplicity of piles as required by many other ground storage systems. The bridge provides maximum volume for the prevailing conditions. The 60-in.-wide belt conveyor alongside the pile delivers to the bridge belt conveyor by means of a special, high tripper propelled by the bridge through a draw bar. The bridge itself has a span of 400 ft on track centers and its structure and traversing mechanism follow conventional ore-bridge construction.

Puerto Ordaz in Contrast to Duluth

A purely functional but perhaps oversimplified approach to the problems of the Orinoco reclaiming and shiploading system is to consider it as the means for controlling the flow of ore from storage pile to waiting ships. This function in its simplest form is achieved at the docks of Upper Great Lakes ports, with their large bins or pockets, from which Mesabi ore is chuted directly into the holds of the boats. (Regardless of size, lake carriers are always called "boats".)

At Puerto Ordaz, practically every condition contrasts sharply with that at Duluth or Superior—except the requirement for dependable and fast operation. The system had to be capable of serving nearly every type of ocean vessel, including 40,000 to 50,000-ton ships not yet designed. The river at dockside was known to rise and fall about 40 ft annually. Flexibility was required to fill irregularly spaced hatches selectively, to trim both fore and aft and thwartships, while avoiding the rigging characteristic of ocean ships. For these and other reasons it was decided that the cost of a bin system would be prohibitive and its operation impractical.

With ground storage, a belt conveyor system provided the only practical method of transportation from pile to ship. Despite the many and varied requirements of the shiploader, it presented no extraordinary design complications. The real problems concerned the method of reclaiming the ore from the pile at rates up to 6,000 tons per hour for each system, and keeping it under the control of the shiploader operator over distances up to 3,000 ft.

Obviously, ore bridges or shovels offered the most positive means of reclaiming even the stickiest ore that could be anticipated, but the cost was considered prohibitive for this capacity. Naturally, they would not be needed to handle frozen ore as is often the case in northern operations. A study of the shape and size of the pile indicated that it could be reclaimed most economically by two tunnel conveyors. Sufficient clearance was provided for installing future conveyors large enough to serve two shiploaders. However, minimum shiploading time required assurance of a flow of ore through the tunnel openings that was more positive and dependable than conventional gates and feeders used for stone, coal, and other free-flowing materials. To provide for dealing with any sticky type of ore that might be encountered, it was finally decided that flow could be maintained more dependably with a traveling rotary-plow type of feeder than with other feeding devices (Fig. 3).

This type of feeder has been used in Germany for many years, and small units are in operation in this country for handling iron ore and sinter. It consists of a traveling carriage upon which are mounted bladed arms rotating in a horizontal plane, which plow the ore from a continuous horizontal shelf onto a collecting belt. At Puerto Ordaz each of the four feeders is equipped with two rotors about 11 ft in diameter (Fig. 3). A short transfer belt is mounted on the traveling carriage to take the impact of ore discharged from the shelf. This transfer belt also assists in regulating the flow and improves the loading conditions to the two 48-in.-wide main tunnel belt conveyors. Two feeders serve one conveyor in each tunnel, and together have a normal maximum capacity of 3,000 tons per hour. However, one can feed up to 2,000 tons per hour in an emergency.

Each feeder is interlocked with the master control of the reclaiming system, and its operations are controlled by the shiploader operator. In addition, manual controls on each feeder provide for adjustment of travel and rotating speeds to synchronize its feeding rate with half the carrying capacity of its tunnel belt through a range of speeds from zero to about 500 fpm.

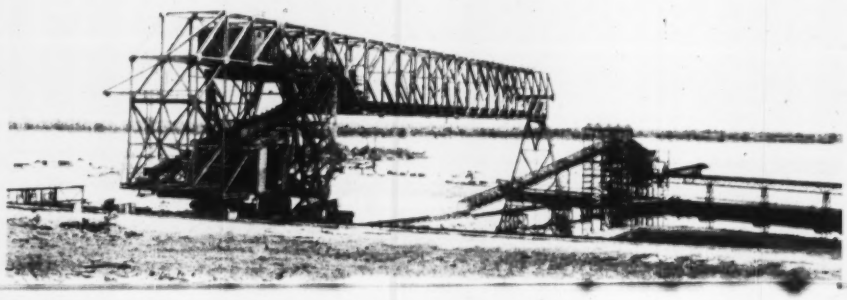
The rotary-plow feeder has a number of advantages over other feeding devices for positively assuring a high-capacity loading operation, among which are the following:

1. Feed opening is continuous for the entire length of each tunnel. This arrangement provides less support for the arching of ore than would a series of rectangular feed openings of practical size.
2. Arch support is partially undercut by the rotating blades, a feature which would require costly auxiliary devices for other types of feeders located beneath rectangular feed openings.
3. Entire feeder travels continuously back and forth along the shelf between predetermined limits. Increments of capacity losses are limited to the distance the feeder travels beneath material that has arched solidly above the cutting range of the rotor blades. Arching over the openings of other types of feeders usually results in a complete stoppage of flow until the arch is broken by poking or other auxiliary means.

Belt Conveyor to Shiploader

Ore from the two 48-in.-wide tunnel belts is transported by a system of 60-in.-wide belt conveyors to the traveling shiploader. En route samples are removed and processed in the sampling plant near the inshore end of the dock, and the weight of ore is recorded by weightometers in the same building. These operations alone could well provide material for a complete paper.

The shiploader (Fig. 4) is of necessity quite versatile in order to meet the conditions described previously. Ore from the long dock belt is received on a short 60-in.-wide transfer conveyor, from which it is discharged to the upper of two 72-in.-wide conveyors, both mounted on a common pivoted boom. The lower shuttle conveyor may be extended to trim the hatch of the largest vessel or retracted to clear the face of the dock.



Use of ore bridge (seen under construction) for bedding ore was dictated by space limitations and topography. Available area for 700,000-ton initial storage pile was relatively narrow. Bridge provides maximum volume for prevailing conditions.

The boom may be raised and lowered through an arc suitable for loading small ships at low water or the largest anticipated carriers at high water level. Trucks on standard-gage tracks and the traversing mechanism are similar to those used for the ore bridges. They are powered by direct current to provide a top speed of 200 fpm for movement from hatch to hatch.

One of the most interesting problems of the entire project was encountered in the system of belt conveyors from reclaiming tunnels to shiploader. It was necessary to transport a maximum tonnage in the shortest possible time, which required eliminating potential delays wherever possible. This involved such important design considerations as:

1. Maintaining a dependable and reasonably uniform feed to the belt system.
2. Loading the belts at the practical maximum cross-section without excessive spillage at transfers.
3. Operating the entire system as a unit despite its length and the number of conveyors involved.
4. The necessity for rather frequent starting and stopping while the loader moves from hatch to hatch.
5. The necessity for reduced capacity for trimming individual hatches.

Direct Current Used

The use of direct current for the entire reclaiming system provides various advantages. It enables all the units to be tied together electrically throughout the entire speed range and under the control of the shiploader operator. Thus, it reduces the cumulative time delays resulting from starting and stopping the various units in sequence. Sequence control is necessary with the use of alternating current, and the loss of time for each start-stop or slowdown would have been appreciable.

However, the direct-current hookup required special consideration for this relatively long and heavily loaded system of belt conveyors. When two or more consecutive belts are started simultaneously, the speed of the foot end of the leading belt is less than the speed of the belt over the head pulley of the preceding conveyor. This is due to the stretch of standard fabric belts resulting from accelerating stresses. Obviously, until the two belts reach the same speed, the leading belt receives more than its normal cross-sectional load of material from the preceding higher-speed belt, and spillage may result. To overcome this condition, belts of steel-cord type were used in the reclaiming system as they provide minimum stretch within the design limits.

Throughout the entire project, safety of personnel and protection of equipment were considered carefully. One of the most important devices for protecting and increasing the tonnage life expectancy of the various main belts is the use of transfer conveyors. They consist of short belt conveyors equipped with relatively small head pulleys, rubber impact supporting idlers and belts especially designed for impact and abrasion. All have vertical skirt plates with virtually no sloping chutes. In fact, they actually take the place of chutes. Provision is made for changing the belt quickly. These transfer conveyors are designed to perform the following functions:

1. To provide a positive means of changing the direction of the tremendous flow of ore at 90-deg transfers without the use of chutes.
2. To assure dependable transfer of ore that might otherwise build up in the valley angles of ordinary sloping chutes.
3. To reduce wear on the main belt beneath the transfer by discharging sharp abrasive ore at a speed near the main-belt speed and with the shortest practicable drop.

The metal detector used at the foot end of primary belt conveyor No. 2 serves to protect that expensive belt when a magnetic object is conveyed into its field. At that time, it will provide the impulse for the following functions:

1. Mark the belt at the approximate location of the metal object.
2. Sound a warning siren.
3. Stop forward rotation of the car dumper.
4. Stop the feeder beneath the primary crusher.
5. Stop the main primary conveyor No. 2 when the object is within a few feet of the head end.
6. Permit crusher to continue operating.

The entire project required extremely careful planning and scheduling. The field erection stage received particular consideration because of the size and complex nature of the equipment. The diversity of crafts involved, the location of the plant site, and the short time allowable for installation precluded any extensive training program for native labor. As a result, it was necessary to import a high percentage of North American craftsmen with the attendant cost of their transportation, housing, insurance, etc. Obviously, it was necessary to utilize every available man-hour effectively, not only to meet construction cost estimates but to maintain high morale within the labor force.

Every phase of design, manufacture, and erection was carefully analyzed, and a time schedule was established covering each operation as well as the delivery of each purchased component. The overall picture was set up in the form of a chart and maintained for reviewing progress from day to day. The extensive analysis made for the field erection period was particularly helpful when it became necessary to reduce the completion time from 27 months to approximately 20 months midway of the prosecution of the contract. Splendid cooperation by all participants enabled this to be done.

It is difficult to cover all phases of a project of this magnitude in one brief paper. Any one of several operations and pieces of equipment contains enough material for an individual paper.

The final designs are the result of cooperation between the owner and his engineers, and the contractor and his subcontractors. Contributions were made by all branches of the engineering profession—civil, mining mechanical, electrical, and industrial. Operating results will be available after the plant starts operation in January 1954. At that time this plant will do its job as a most important link in making Cerro Bolivar ore available to the blast furnaces of America and the world.

All operations of reclaiming ore from storage and loading into ships are controlled by operator in shiploading control house (left). Traveling shiploader, not seen in this construction view, is adjustable to 40-ft variation in river level occurring at Puerto Ordaz.

Address before Membership Luncheon

at ASCE Annual Convention in New York

RALPH A. TUDOR, M. ASCE

Under Secretary,

Department of the Interior, Washington, D.C.

Interior Department policy reflects new approach

It has truly been an experience to be associated, even in a subordinate capacity, with the President and his Cabinet. They are a group of capable men who are trying their utmost to guide the destinies of this country. For the most part they are men who have already succeeded and made their record in life. They are not seeking further power or further glories. They approach problems with open minds and seek the facts. They move thoroughly though quickly to answers they believe to be the best for the whole country. With affairs and interests as complicated as they are, this is not easy. Nonetheless, a great deal has been accomplished.

In the Department of the Interior we have our fair share of problems.

We have Fish and Wildlife, Mines, Geological Survey, National Parks, Territories (including Alaska, Hawaiian Islands, Guam, American Samoa and others), Bureau of Land Management, Indians, the Bureau of Reclamation, Bonneville Power Administration, and several other functions. By their very nature these bureaus are frequently in conflict with one another and often with some other Department. They all come in close and day-to-day contact with the public. The net effect is that we always seem to have one or more critical problems that require immediate attention.

Some of our problems are of greater significance to the country than others, but I think none required more urgent and thoughtful attention than that of establishing a sound policy concerning the generation, distribution and sale of Federal electric power. This is a problem which has national interest and concerning which there are deep and divergent convictions throughout the country. There are strong proponents for public power and others just as strong in opposition. The thinking of the new Administration does not agree with either extreme. Neither does it agree with several of the policies that had been advocated and practiced by the former Administration. It was necessary that a simple, clear and fundamental statement of policy be developed and enunciated by us.

Since the Department of the Interior generates a fair share of the Federal power at its various Reclamation dams, and is the marketing agency for all the power generated by the Corps of Engineers at the flood control and navigation dams, it was logical that we carry the burden in this matter. The Department does not have anything to do with the power generated and sold by the TVA, and the power marketing policy which was recently promulgated does not apply to that organization.

Policy Reflects Applicable Laws

In developing the policy, we first examined all the laws that have been passed and which are applicable to the particular question. We also examined the reports and recommendations that have been made by congressional committees from time to time and the statements that have been made by the President. Based upon these documents, and particularly the laws that have been passed, we prepared a proposed policy for the generation, transmission and sale of Federal power. It was discussed at length and in detail by our own secretariat. When it had taken preliminary form, conferences were held with the Chairman of the Federal Power Commission, the Chief of Army Engineers, the Deputy Director of the Bureau of the Budget and several congressional leaders so that their views might be had and incorporated where appropriate. Finally it was taken to the Cabinet and to the President before it was finally accepted.

I think it is one of the most significant statements of policy on any domestic matter that the Administration has yet made, and I think it is sound.

It was released to the press on August 18, and I must confess that we were very much interested in the public reaction it received. It is a controversial question and it was featured and editorialized in the press in almost every state in the Union. We were criticized on the one hand for being too liberal and on the other hand for being too conservative. We were the target and we were bracketed. However, when the smoke had cleared, I was very pleasantly surprised to find that the editorial comment was predominately favorable.

The comments and discussions have by no means stopped and the argument will probably continue for many months. It is a national issue and will probably remain so.

The Administration's power policy

is an honest statement of what we believe the law to be. Where the law was not entirely clear or where it did not cover the subject fully, we have tried to interpret it for the general good of the entire country and have endeavored to avoid favor or penalty to any group or area.

We were first concerned with the policy regarding generation of electricity. In so far as the Bureau of Reclamation is concerned, our primary responsibility is the reclamation of arid and semiarid lands. The production of power is fundamentally a by-product of this reclamation. The Congress has never given us any responsibility for supplying the power needs of any area. That responsibility truly rests with the people locally. It is our responsibility to give leadership and assistance in the conservation and wise utilization of our natural resources. We have no right, nor do I think we should assume the right, to the exclusive responsibility for the construction of dams or the generation, transmission and sale of electric energy.

Contrary to past practices, we will not oppose the construction of generating facilities by local interests either public or private when these local interests are willing and able to provide the facilities in accordance with licenses properly issued by the Federal Power Commission.

Hells Canyon Controversy

The controversy concerning the Hells Canyon development serves to illustrate the point just made. In this case the Bureau of Reclamation has a plan to build a single very large dam on the Snake River in a stretch where it serves as the border between the States of Oregon and Idaho. This project has never been authorized by Congress. In fact, it was considered by the Congress twice and on one occasion no action was taken while on the other it was specifically rejected.

A couple of years ago the Idaho Power Company initiated an application for a permit from the Federal Power Commission to build a single, smaller dam on this reach of the river. Later this application was amended to include three dams that would develop the same total head as the single large Federal project. The then Secretary of the Interior and the Secretary of Argiculture objected to the issuance of any such license and argued that the Federal Power Commission had no authority to issue one. The action was unusual for the Secretaries did not simply recommend rejection of the license application, but became active protestants and litigants before the Federal Power Commission. This has only occurred twice before and all three exceptions have been since the beginning of 1950. Prior to that time the Department of the Interior had followed the customary procedure of advising the Federal Power Commission concerning licenses which were under consideration and abiding by the action of the Commission.

When we took over the responsibility of the Department of the Interior earlier this year, we found ourselves litigants in the case of Hells Canyon and arguing that the Federal Power Commission was without authority in the matter. We reviewed the question carefully and concluded that Congress had delegated to the Federal Power Commission the authority and the responsibility for considering license applications. The Congress had further charged the Federal Power Commission with rejecting applications which did not reasonably develop the resources involved. In other words, the Federal Power Commission has all the authority and responsibility for safeguarding the interests of the Federal Government and of the people in these matters.

We therefore withdrew as litigants before the Federal Power Commission and thereby simply let the procedures that had been standard practice to all previous Administrations until 1950 be followed. We have taken no position in support of or opposed to the proposal of the Idaho Power Company. We have advised the Federal Power Commission we believe that certain minimum restrictions and requirements should be written into the license *if* it is granted. We have also made available to the Federal Power Commission all reports and studies that we have heretofore made. Finally, we have made available all the personnel in the Department of the Interior that have had any part in the plans for the high Hells Canyon dam; I assure you that we have not restrained their testimony. Since the Department made the studies and reports on the Federal Hells Canyon project, all the testimony of our witnesses will be in support of that development. We will present all the facts at our disposal. We will not contest the right of the Federal Power Commission to make a decision in the matter and we will abide by that decision when it is rendered.

I recite this matter of the Hells Canyon controversy simply to point out that our new policy is to let the ordinary processes of the administration of law be followed, and that the Department of the Interior will not oppose development by local interests.

Cooperation Vital to Progress

We believe strongly that to adequately develop the resources of the country will require the partnership and participation of all of the interested parties. This includes the Federal Government, the states, local public utility districts and cooperatives, municipalities, and free enterprise. This is not a new concept for it has been worked in many fields in the past. Congress has recognized it, for by law the Bureau of Reclamation and the Army Engineers are required to submit all plans for Federal water development projects to the states for their review. There are also cases such as the Central Valley in California, the Bonneville Power Administration in the Pacific Northwest, the Southwestern Power Administration in Texas and Oklahoma, where Federal, local, public, and free-enterprise power are integrated together to the advantage of the community.

We feel, however, that all too frequently in the past this partnership has not been as amicable as it should have been. The Federal Government has been too willing to use the threat of a "yardstick" or the construction of competing facilities to induce negotiations. I am confident this is not necessary and that there can be a fair solution to the problems of any area by the various interested parties working together, and particularly by the Federal Government showing a sympathy and a willingness to assist the local people in their problems. I do not believe that the Federal Government should dominate or monopolize the development of any area.

The Department of the Interior will continue to plan and to recommend construction of those projects which are economically sound, of advantage to the community, and where the local interests, either public or private, cannot for one reason or another perform the work themselves. Generally this will be the large multiple-purpose projects which because of their size, or non-reimbursable features, or interstate complications, are beyond the means of local effort.

There are strongly divergent opinions regarding the extent to which the Federal Government should build transmission lines. Some interests would totally deny the

Federal Government the right to build any such facilities and others insist that very extensive systems be provided. Generally it has not been advocated that the Federal Government enter the distribution field for retail customers, but there are innumerable examples of long, expensive lines built to small load centers and other lines which either duplicate local facilities or would have been advantageously provided from local resources, if the Federal Government had not entered the field.

In our new power policy we anticipate that the Department of the Interior will normally construct and operate transmission lines that are economically feasible and necessary for the proper interconnection of Federal generating plants. In order to get the maximum benefits out of a group of hydrogenerating plants within reasonable transmission distance, it is generally advisable to interconnect them and to operate them jointly. This customarily has the advantages of providing more prime power and of increasing the safety factor. If properly done, it is economically sound.

The Department of the Interior will also build and operate transmission lines to carry energy to load centers if these facilities cannot be provided by local, public, or free enterprise at reasonable terms. This should not include transmission lines to load centers which are too remote to be served economically.

One of the most important parts of any Federal power policy is the matter of preferred customers. The first law that was passed having to do with the generation of power for the Federal Government was the Reclamation Law of 1906. It provided that "municipal purposes" should be given preference in the disposal of power generated as a by-product of reclamation. In the Bonneville Act of 1937, the Fort Peck Act of 1938, the Reclamation Act of 1939, the Flood Control Act of 1944 and various other Acts of Congress, this preference has been stated in various ways. However, throughout all these Acts there runs a general and very clear directive that "domestic and rural customers" be given primary consideration and that wherever a preference is to be shown between publicly owned utilities or cooperatives on the one hand and privately owned utilities on the other, the former will be given preference. The new power policy properly recognizes these preferences and our administration of it will be to that end. We do not believe, however, that the law intended that the preference privilege should be used as a means to provide power for large industrial consumers at the expense of domestic and rural consumers who may be served by a privately owned utility.

In Defense of REA

There has been considerable fear expressed that our administration of the preference clause in our new power policy will give less than reasonable protection to the rural electrification associations around the country. This will not be the case for we wholeheartedly believe in the legitimate REA. These REA's have been set up to transmit and supply power in relatively sparsely settled rural areas that would not otherwise be serviced. They have brought electricity to farmers and isolated customers where these modern conveniences could not otherwise be had. The customers they serve repay the cost of the facilities, including interest on the investment. Under these circumstances they are certainly entitled to first call on Federal power.

It is not intended in the administration of our power policy that we will customarily take Federal power that is being supplied to other domestic and rural customers in order to serve new or expanded REA's. However, provision is being made in new contracts to take care of a reasonable development period for REA's. In addition, the continued normal increase in Federal generating capacity should be more than sufficient to meet the prior needs of these REA's.

We believe that there has been some lack of realism in the past in setting rates for Federal power and, in some instances at least, these rates have been set too low to return the Federal investment plus interest within not to exceed 50 years. We believe that this is a reasonable requirement and should not be violated. If the power cannot be generated and sold at rates which will accomplish this purpose, in all probability the plant in question should not be built. There is no justification in passing any cost of the generation and transmission of power on to the general taxpayer. We believe that the rates should be reviewed at intervals not exceeding five years and adjusted to reflect any additions to the system or changes in its operation and maintenance. In some cases this may permit a reduction and in others it may require an increase.

With rare exceptions, the Federal power is sold wholesale to public and private utilities for distribution to the ultimate consumer. In the past, the Department of the Interior has insisted that it retain full control over the resale rights of its customers. We have changed this and do not propose to impose ourselves, particularly on the publicly owned utilities. After all, they are locally controlled by their own customers and we believe are in a position to take care of themselves. In the case of the privately owned utilities, we believe that the regulatory bodies of the states will ordinarily do an adequate job of control. However, we do propose to reserve to ourselves the right to seek court relief if there is a flagrant violation and unreasonable profit from the resale of Federal power.

A Significant Change in Policy

Perhaps the most significant change in our power policy from that which has been practiced in the past lies in the fact that we believe the local interests should have a full partnership right to participate in the planning, ownership, and operation of local power facilities. We believe that the local interests are fundamentally responsible for supplying their own needs and our purpose is to aid and assist. The Federal Government does not have the exclusive responsibility or right to provide power for any area, basin, or region. Neither do we have the exclusive right to the development of any facilities. We are concerned that no resources be wasted but adequate protection against such malpractices is provided under the law, and responsibility for this has been delegated to the Federal Power Commission. We will always help and assist that body in any way they may desire. We will not endeavor to take over the authorities or responsibilities which Congress gave the Federal Power Commission nor will we endeavor to impose our will on any local area.

Another important change in the policy is that the Department of the Interior will not promote or oppose the creation and expansion of publicly owned utilities. Whether a community or area is served by a publicly or a privately owned public utility is something we believe the people of an area should decide for themselves. It is not a matter of concern to us.

We believe strongly in the principle that it is the role of the Department of the Interior to work with the local interests and to aid them in every proper way but to avoid taking over their responsibilities and authorities.

Summary of address before Mass Transportation Luncheon, at ASCE Annual Convention in New York

Mass Transportation—Can we afford it?

MARCUS NADLER, Economist, Central Hanover Bank and Trust Co., New York, N.Y.

According to the best available estimates, the expenditure required to make good the deficiencies in highways and streets alone at the end of 1953 would be over 40 billion dollars. To this must be added the expenditures which would have to be made to meet the deficiencies in airport facilities and the railroads. Taken together, the amount involved is indeed very large. Moreover everyone is fully conscious of the fact that practically every city is suffering from hardening of the arteries and from inadequate parking facilities. That there is a need to be met is taken for granted.

The prime question that arises is whether the nation can afford to meet it. This question divides itself into two parts: (1) the problem of economic costs, that is, do we have the physical means (manpower and material) to meet the deficiencies without harming other phases of the economy; and (2) the financing problem, that is, can we raise the necessary funds to meet the costs without imposing too great a burden on the taxpayers? Of these two questions, the problem of economic ability is of far greater importance. The question specifically is: Can we use the labor and raw material that will be required to meet the transportation deficiencies without curtailing our ability to meet other basic needs which may be even more important? Can we at the same time continue with the defense program?

During the war, since the economy of the country could not provide both guns and butter, the choice was simple. The nation chose guns with the result that the production of many consumer articles was either stopped entirely or drastically curtailed. An analysis of current economic conditions reveals that the country is now economically capable of meeting the transport deficiencies as well as the demands of national security and at the same time providing for all the needs of the civilian population.

The productive capacity of the country at present is higher by over 50 percent than it was at the end of 1945. The civilian labor force at the end of June 1953 was placed at 64.7 million as compared with 55.6 million in 1940. The capacity of the steel industry as of January 1, 1953, is 117.5 million tons as compared with 81.6 million in 1940, and the output of portland cement had risen from 10.9 million barrels monthly in 1940 to a monthly average of 20.7 million barrels in the first half of 1953.

Moreover, all indications are to the effect that the economy of the country is headed for a readjustment, and during this period the meeting of the transportation deficiencies could to a considerable extent counteract a decline in business activity. From the economic point of view therefore the question is not whether we can afford it but rather whether we can afford not to go ahead and meet the transportation deficiencies.

The financial question, while of lesser importance, is more complicated. It is evident that the cost of meeting the transportation deficiencies cannot be met by imposing additional direct taxes. Both individual and corporate taxes have reached levels where they are hampering private initiative. Local taxes are already burdensome and will continue to rise.

Financing to meet the transportation deficiencies therefore would have to be done on a self-sustaining basis, so that the taxpayer does not pay it directly but rather by what may be termed a "use tax." In 1952, gasoline and registration taxes paid by motor-vehicle owners amounted to over 4,880 million dollars. If it were possible for this money to be used efficiently and exclusively to meet the transportation deficiencies, it would be ample in so far as highways and streets are concerned. The problem therefore is to see that the indirect taxes which motor-vehicle owners already pay are used to meet these deficiencies.

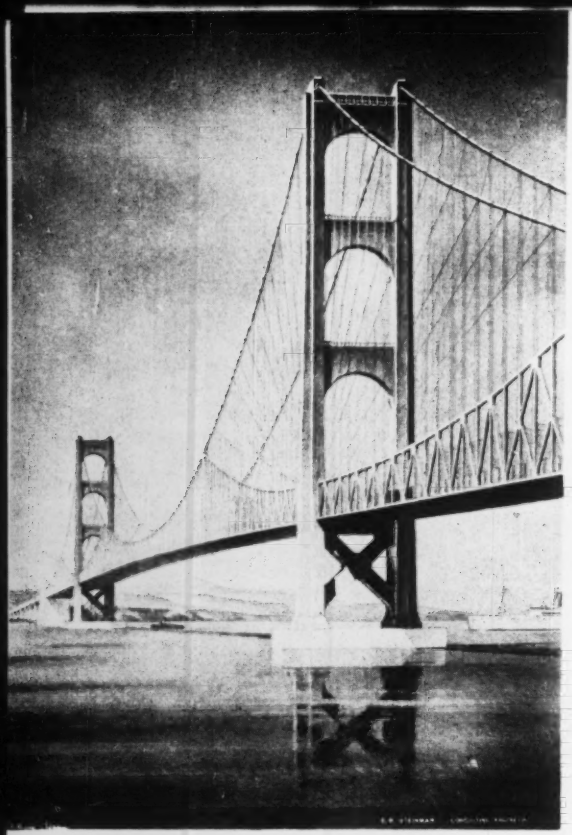
How would you do it?

Some of the most fascinating chapters in the life and memory of an engineer are those which deal with the unusual and unexpected situations which almost got him down but from which he finally emerged the victor—H. J. Gilkey

A department store owner cannot afford to lose a Christmas rush. A large part of the year's revenue is produced between November 1 and Christmas, and many items that are usually slow moving, move fast in this period. To rebuild any part of his store, therefore, he cannot start demolition before January 10, but has to complete his foundations and the rest of his construction by November 1 of the same year. It looks impossible, especially if the new building is 17 stories high. Abraham & Straus did it in Brooklyn, N.Y. How would you do it? For solution, see page 100.

EDITOR'S NOTE: This is the nineteenth in a series which started in the February 1952 CIVIL ENGINEERING. In the April 1952 issue an article, "The Unexpected in Engineering: The Bugs," explains the project and enlarges upon the central theme that problems of the past created the practice of the present; that "The engineering of today rests upon a coral reef; sturdy remnants of yesterday's bugs." The process is a continuing one; there will always be today's and tomorrow's bugs to add zest and gray hairs to the practice of a profession that by its very nature must cantilever from a codified past to an untried future. "Long live bugs" is an ever-present challenge to the virility and ingenuity of the engineer. If you have a good bug, why not share it? H. J. G.

The above problem was submitted by CHARLES B. SPENCER, M. ASCE, New York, N.Y.



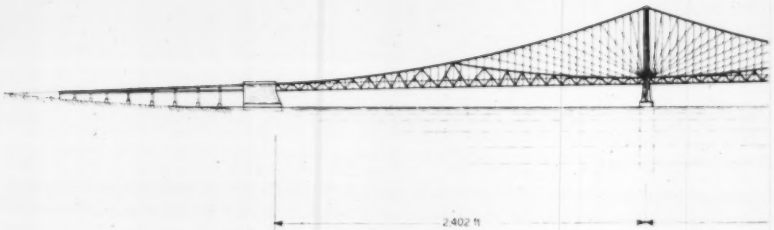


FIG. 1. High cost of deep (400-ft) channel piers dictates long span. Tall slender towers preclude use of tower stays, and use of cable stays is indicated. Florianopolis-type stiffening trusses reach depth of 165 ft at quarter points of main span and mid points of approach spans.

When built, 5,000-ft main span of Messina Strait Bridge will be world's longest. Structure has two decks, upper one for highway traffic and lower one for rail traffic. Cost of bridge is estimated at about $60,000,000.

Messina Strait

D. B. STEINMAN, M. ASCE

For three thousand years the perilous navigation channel between Italy and Sicily has been dreaded by mariners. In ancient poetry and legend it was the fabled passage between Scylla and Charybdis, with its storm-lashed rocks and destructive whirlpools fraught with terror to the boldest navigators.

For a century, there has been talk of the possibility of a bridge across these waters to connect the island of Sicily with the Italian mainland. Eighty years ago, sketch plans for a proposed bridge across the Strait of Messina were actually published. At that early date, the proposal was fantastic. The science and art of bridge building had not yet reached a stage permitting successful solution of the problem for the extreme span lengths and foundation depths required.

The century-old dream of a bridge across Messina Strait has at last reached the stage of practical feasibility. The bridge-building art has advanced sufficiently to offer a thoroughly safe, scientific, and practical solution to the problem. Public and official enthusiasm and backing have been enlisted in active support of the project. Preliminary surveys have been made, and engineering design studies and plans prepared. But for the problem of cost, an estimated $60,000,000, construction of the bridge could begin today.

In 1950, Italian authorities retained the writer to prepare preliminary plans for a combination railroad and highway bridge to connect Italy and Sicily across the Strait of Messina. The crossing is two miles wide over water 400 ft deep. The proposed bridge is of the suspension type, and its main span of 5,000 ft will be the longest in the world. In fact, its side spans of 2,400 ft each will be longer than the main spans of all other bridges except the Golden Gate, George Washington, and Tacoma Narrows. The foundation depth also establishes a new record. The two main piers will have to be sunk to rock at the bottom of the strait by the open-caisson method. The stiffening trusses, of the type conceived and developed for the Florianopolis Bridge in Brazil, would attain a depth of 165 ft at the quarter points of the main span and at the mid-points of the side spans. This feature, combined with a beautiful system of radiating cable stays, will make this the most rigid suspension bridge ever designed, despite its record-breaking length of 9,800 ft in the three spans. This new maximum in suspension-bridge stiffness is required for railroad loading, aerodynamic stability, and earthquake resistance.

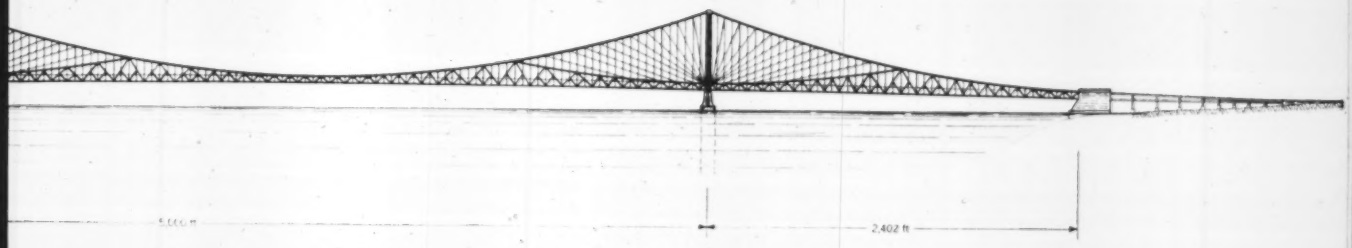
The proposed crossing of Messina Strait would be a double-deck bridge, the lower deck to be used by the railroads and the upper deck by automobiles and trucks. The main source of revenue would be from the railroads which, by water ferry across the strait, now carry more than a quarter-million carloads of fruit to the mainland each year. Sicily is a major grower of citrus fruit for the European market. According to the latest figures, this railroad traffic from Sicily now amounts to more than 280,000 freight cars of fruit and other produce shipped yearly by rail ferry across the strait to the continent.

The bridge, aside from greatly shortening the transportation time, would also save the shipments from the hazards of being ferried across the rapids and whirlpools of the strait, which have taken a heavy toll of shipping throughout history. The important saving in waiting time and crossing time, as compared with the rail ferry, would greatly increase the shipping radius for perishable fruits and other produce, thereby expanding the market area for Sicilian export trade. The availability of the bridge would also stimulate the growth of truck traffic to supplement rail traffic between Sicily and the mainland.

Automobile traffic across the strait would be enormously facilitated, and Sicily would be developed as an attraction for the tourist trade. Sicily would be liberated from its age-old feeling of insularity, and a new spirit of progress would be developed with the stimulation of commerce and of tourist traffic. The bridge is a long-dreamed of link with the rest of the world.

Deep Piers Dictate Long Span

The problem of bridging the Strait of Messina is not an easy one. Obviously a record-breaking length of span is required to minimize the number of deep piers required.



Suspension Bridge to span 5,000 ft

Consulting Engineer, New York, N.Y.

Cable stays, trusses, and two decks ensure rigidity

Foundations in water 400 ft deep are necessarily costly; each main pier will cost approximately $8,000,000. The problem is rendered more difficult by the requirement that the bridge shall carry rail traffic in addition to highway traffic. For moving railroad loads, maximum rigidity of span design is required and excessive span length must be avoided. Full consideration of these two conflicting requirements—foundation economy versus railroad loading—led to the adoption of a main span of 5,000 ft, the shortest span that would fit the crossing with only two main piers in deep water. (See Figs. 1 and 2.)

The difficulties of the problem are further aggravated by the physical conditions of the crossing—strong currents, swift tides, and violent storms. Added to these hazards is the proximity to volcanic activity, with accompanying seismic disturbances. A bridge design for this crossing must take all these elemental forces into account.

A generation ago, the feasibility of a span of 3,000 ft was seriously questioned. Now bridge engineers confidently agree that suspension-bridge spans as long as 10,000 ft are practicable. It took forty years (1889 to 1929) to increase the world's record span length from 1,700 to 1,850 ft (from the Firth of Forth Bridge to the Detroit Ambassador Bridge). Then, in the next 8 years (1929 to 1937), in two leaps, the record span length was more than doubled, from 1,850 to 4,200 ft. It is a relatively small advance to a span length of 5,000 ft.

All the other difficulties present no problems that are essentially new. Bridges have been safely designed and built to withstand wind forces and earthquake shocks. Foundations have been safely constructed in deep water and in swift tides. Practical and scientific methods for handling all these problems have been developed. Bridge foundations have been safely sunk to a depth of 242 ft, and it is only an extension of known principles and methods to sink them to a depth of 400 ft. The cost runs up, but the basic problems remain unchanged. More ingenuity is required, not to establish feasibility, but to keep the cost down.

The only feasible or logical type of bridge for a span of 5,000 ft is the suspension type. The world's longest cantilever span is 1,800 ft, attained in 1917 in the Quebec Bridge after two disastrous erection failures. Since then, no cantilever span longer than 1,500 ft has been attempted. For spans exceeding 800 ft, and even for shorter spans, the suspension type is now generally adopted as preferable. Both esthetic and economic considerations have governed this change. Most cantilever bridges are angular and clumsy in appearance, and some are monstrosities. For spans of 2,000 ft or longer, the cantilever type is economically and physically out of the question.

Both technical and artistic considerations had to be kept in mind in developing the design for this crossing. For a bridge of this magnitude and in a location so prominent, it would be a crime to aim for anything less than artistic perfection. The beauty and the grandeur of Nature's scene have been defaced by too many "engineering structures" that are commonplace, ugly, or depressing. Bridges that are eyesores and monstrosities represent a betrayal of the professional trust. Less effort is required to design an ugly structure. No bridge engineer is worthy of the name unless he is inspired with a passion to make his structures beautiful.

Florianopolis-Type Stiffening Trusses

In the writer's first book, *Suspension Bridges and Cantilevers*, it was shown that, for a railroad suspension bridge, a stiffening-truss depth of $\frac{1}{40}$ of the span is required. This is necessary in order to limit the deflections under moving train loads so that the maximum deflection gradient, or change of grade, shall not exceed 1 percent. On a highway bridge, vehicular traffic is generally distributed over the length of the span, and the small increase in grade due to span deflection is not material. On a highway suspension bridge of long span, with correspondingly heavy cables, the moving automobiles are like flies on a clothesline. But on a railroad suspension bridge, the concentrated loads of locomotives and trains may produce deflections with serious adverse grades unless the span is adequately stiffened against such deformations of the cable curve.

To give the bridge adequate rigidity to resist railroad deflections, aerodynamic oscillations, and earthquake forces, while keeping artistic considerations in mind, the following

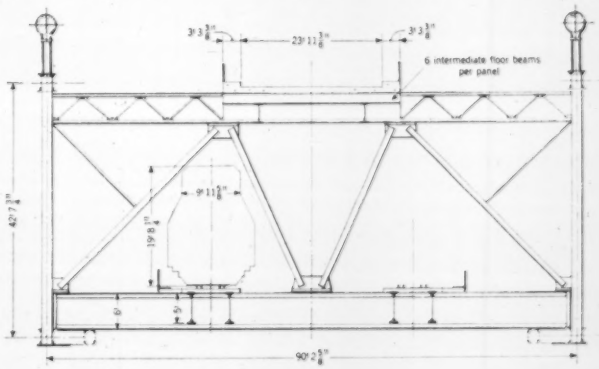


FIG. 2. Cross section of deck shows how rail and vehicular traffic will be carried. Box-like cross section increases rigidity of structure.

features in the design for the Messina Strait Bridge have been developed and combined:

1. The Florianopolis type of stiffening truss.
2. A system of radiating cable stays.
3. A double deck with a double system of lateral bracing (for torsional rigidity).
4. A cross section with wide lateral openings, yielding a section of assured aerodynamic stability.

The fourth of these features was adopted to solve the aerodynamic problem at the source—prevention instead of cure. It is more scientific (and more economical) to eliminate the aerodynamic forces than to build up the structure to resist them.

To provide the indicated truss depth of $^1/_{40}$ of the span for a railroad suspension span of 5,000 ft, with the conventional design of stiffening truss, would call for a parallel-chord stiffening truss 125 ft deep. This would be clumsy, awkward, and uneconomical.

For the Messina Strait Bridge, the problem has been solved by an adaptation of the Florianopolis type of stiffening truss, making it continuous in all three spans, yielding maximum rigidity and economy, and at the same time producing an esthetically pleasing structure. This truss layout, as developed and applied in the present design, yields a truss depth of 165 ft at the quarter points of the main span and at the mid points of the side spans. These are the points at which maximum truss depth is required for efficiency, rigidity, and economy. Instead of the indicated necessary depth of $^1/_{40}$ of the span, a greater truss depth of $^1/_{30}$ of the span has thus been provided at the critical points so as to yield still greater rigidity and aerodynamic resistance.

The Florianopolis type of stiffening truss was first conceived and applied in 1922–1926 for the Florianopolis Bridge in Brazil, which is still the largest bridge in South America (span 1,114 ft). After the writer's firm secured that engagement in an international design competition, in which it had submitted a conventional suspension bridge design with a parallel-chord stiffening truss, the firm decided to change the design by introducing a modified form of stiffening that would be even more efficient than the previous conventional design. This new form, yielding four times the rigidity of the previous design with only two-thirds as much steel in the stiffening truss, was adopted. The revision yielded a considerable saving in cost throughout the structure, and promptly won the enthusiastic approval of all concerned.

Advantages of Florianopolis Truss

The novel suspension design adopted for the Florianopolis Bridge has the following advantages, offering increased economy and efficiency:

1. The middle half of the top chord of the stiffening truss is saved by utilizing the cable to replace it. One principal member is made to take the place of two. Since these structural elements carry opposing stresses, the result of the consolidation is a subtraction of stresses instead of an addition of sections.

2. The new profile of the truss is more economical and rigid, since it conforms to the variation of maximum bending moments along the span. In a suspension-bridge stiffening truss, the greatest bending moments occur near the quarter points of the main span (and at the mid points of the side spans), and the new truss form has the greatest depth at the main-span quarter points.

The net result of this novel change in design as applied to the Florianopolis Bridge was a reduction in cost (through an actual saving in material), an increase in safety and longevity (through reduced unit stresses), and an increase in efficiency (as measured by reduced deflections).

For the Messina Strait Bridge, the Florianopolis form of stiffening truss has been extended over all three spans and the truss has been made continuous across the towers. Studies of the rigidity and aerodynamic stability of suspension bridges have shown that both rigidity and stability are very materially enhanced by making the stiffening truss continuous at the towers. Even for the flexible spans of the Tacoma Narrows Bridge, continuity would have increased the rigidity by 24 percent. In more highly stiffened spans, the percentage increase of rigidity secured by continuity is very much greater.

Cable stays, extending from the ends of a span to selected points of the cable, provide a simple and inexpensive means of increasing the rigidity of a suspension bridge and securing aerodynamic stability. At comparatively small cost, the writer has stabilized three suspension bridges in this manner.

The natural thought when considering cable stays is to run the inclined stays from the top of the tower to points along the roadway (tower stays). Such a system of stays may be appropriate and effective in a suspension bridge with rigid masonry towers, as in the monumental and historic Brooklyn Bridge. Tower stays are, however, inappropriate and ineffective when they are applied to the slender, flexible steel towers of modern suspension bridges. Such tower stays simply form a three-point connection (main span, tower, and side span) with all three points naturally moving in the same direction. That does not constitute anchorage. Cable stays, on the other hand, represent firm anchorage to a fixed point—one that does not participate in the motion. Only thus can motion be arrested and prevented.

John A. Roebling used some inclined cable stays on his Ohio River Bridge at Cincinnati (1867, span 1,057 ft). In his famous Niagara Railway Suspension Bridge (1855, span 821 ft), he used inclined underfloor stays, anchoring the roadway to the cliffs below. Inclined cable stays are the equivalent of under-floor stays, merely shifted to a higher parallel position, where they do not interfere with navigation.

Two basic principles which govern the use of inclined cable stays are often overlooked:

1. Holding a point of the cable against up-and-down movement is exactly equivalent to holding the vertically corresponding point of the roadway against up-and-down movement. A point of the roadway cannot move up and down when the point of the cable directly above it is prevented from moving. The forces involved are far too small to overcome the dead-load tension in the suspenders.

World's longest spans

Bridge	Span	Year Completed
George Washington	3,500	1931
Straits of Mackinac	3,800	Awaits financing
Golden Gate	4,200	1937
The Narrows, New York	4,620	(Proposed)
Strait of Messina	5,000	(Proposed)

2. A wire rope under initial tension is elastically and functionally equivalent to a compression member (unless and until the compression force exceeds the initial tension). The shortening under compression follows exactly the same elastic law and is calculated exactly the same way. This applies both to inclined rope stays and to vertical suspenders.

Instead of using wire ropes, we use wire-rope strands, in order to take advantage of the higher modulus of elasticity. Prestressed rope strands are now available in diameters up to $2^{9}/_{16}$ in.

Another fact often overlooked is that both wire ropes and wire-rope strands have much higher structural damping values than ordinary structural members. Structural damping (absorption and dissipation of energy by internal friction or hysteresis) is even more important than mere rigidity in preventing the building up of oscillations and in bringing incipient vibrations quickly to rest.

By the combination of the Florianopolis type of stiffening truss with the radiating systems of cable stays in the design for the Messina Strait Bridge, every point of the cable is held against both vertical and longitudinal displacement. Vertical or torsional oscillations of a suspension bridge cannot occur without deformation of the cable curve, and deformation of the cable curve cannot occur without longitudinal displacement of the points in the cable.

The design of the Messina Strait Bridge provides for a double-deck structure, carrying two railroad tracks on the lower deck and a highway on the upper deck. The tracks are placed on the lower deck to keep the railroad approach grade to a minimum. The highway is placed on the upper deck to give motorists a better view of the surrounding scene. The highway is made 25 ft wide between curbs. Bicycle paths can easily be added.

The double-deck construction is far more rigid against torsional deformation than the usual single-deck suspension bridge. Moreover, it facilitates the effective use of a double system of lateral bracing, with the two decks participating and included in this bracing system. The provision of two planes of lateral bracing, so as to secure the integral effect of a hollow rectangular section in torsion, is a powerfully effective method of augmenting resistance to torsional oscillation. It was this type of oscillation that caused the catastrophic failure of the Tacoma Narrows Bridge in 1940. For the proportions of the Messina Strait Bridge, with a box depth of 40 ft, the double-deck construction with two planes of lateral bracing assures torsional stability and safety in the most violent wind storms and hurricanes, far above the 100-mile wind velocities generally considered as the maximum in bridge design.

This exceptionally high degree of rigidity—lateral, vertical, and torsional—in the Messina Bridge design provides high resistance not only against aerostatic and aerodynamic forces and torques, but also against analogous earthquake forces and vibrations. Despite its unprecedented span length, the Messina Strait Bridge will be one of the safest and most rigid suspension bridges ever designed.

Construction of the two main piers in water 400 ft deep will mean a record pier depth, but methods of deep-pier construction, consistent with sound engineering practice and adequate to take care of the problems involved, are available. A completely safe and satisfactory design has been developed for the construction of these piers, and the estimate of cost is based on that design. The two main piers in this design are 82 ft by 200 ft in cross section, and are to be built by the open-caisson method.

The great depth eliminates the pneumatic-caisson method from consideration. In fact, for this depth, the open-dredging caisson method is the only feasible procedure. In essence (with some variations) the procedure is as follows. A double-walled steel cylinder, or a rectangular caisson with multiple dredging wells is lowered through the water with the aid of anchored guides. Any soft material above the rock is removed by dredging through the open wells. When rock is reached, any irregularities are removed by drilling and dynamiting below the cutting edge of the caisson, until an even bearing is secured. A seal layer of concrete is then placed at the bottom of the caisson by tremie (or by the Intrusion Prepakt process). After the concrete seal has hardened, the caisson is unwatered and the remainder of the concrete is placed in the dry.

Over a range of 10 ft above and below the mean water surface, the concrete pier would be faced with stone masonry, to protect the concrete from abrasion and salt-water action.

The cable anchorages have been designed to rest on rock. Although they are quite massive in dimensions, they present no unusual problems.

Quantities and Total Cost

Total quantities of material required for this bridge are as follows:

Concrete	567,000 cu yd
Cable wire	46,400 tons
Structural steel	74,500 tons

The total estimated cost of the bridge is $59,425,000, or in round figures $60,000,000. This amount does not include approaches, right-of-way, or engineering. Further detailed studies in the final design may be expected to effect additional savings for further reduction of the cost.

The proposed Messina Strait Bridge should be a beautiful and monumental structure, representing the highest advances in the science and art of bridge construction. A bridge at this famed crossing would be a heroic symbol of civilization and human progress. It would be an enduring monument to peace and international cooperation.

Stiffening trusses for Messina Strait Bridge are similar to those used on Florianopolis Bridge, longest span in South America (1,114 ft). This truss design saves about one-third the steel needed for truss with parallel chords.

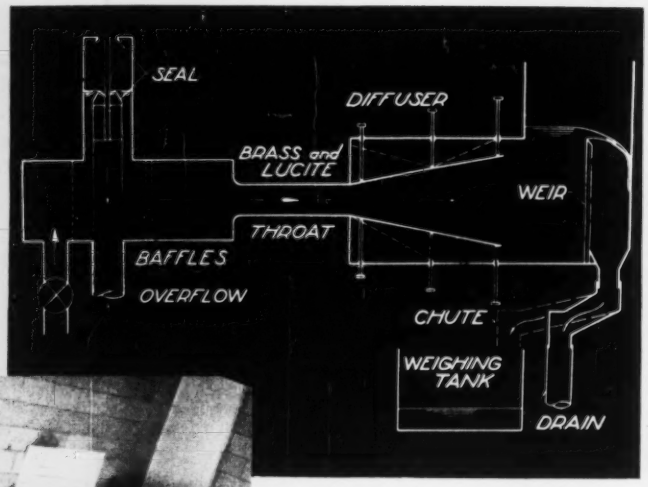


FIG. 2. Water tunnel is in three parts: headwater tank, throat, and diffuser. Water from laboratory supply flows from left to right and is returned via weighing tank or drain pipe.

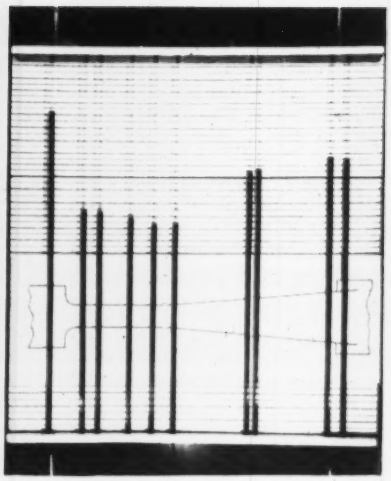


FIG. 3. Manometer panel enables beginning hydraulics students to see how pressure head varies along schematic tunnel drawn on card and slipped behind piezometers, showing where tubes are connected.

FIG. 1. Inner walls of diffuser here form diverging tube while throat portion contains model wing-section. Piezometer tubes shown in picture on wall, and in Fig. 3, have been removed to avoid clutter.

Water tunnel teaches

This description of equipment for a fluid mechanics laboratory is the fourth in a series sponsored by the Fluid Dynamics Committee of ASCE's Engineering Mechanics Division

A small, rather versatile water-tunnel, designed especially for student instruction, is in use at the Hydraulics Laboratory of Northwestern University. Engineering students at Northwestern Technological Institute use it during their first course in fluid mechanics to get a clear picture of the Bernoulli principle.

Since the cost of building this and similar items of apparatus is high, and since maintenance and satisfactory operation demand a significant amount of effort on the part of an instructor or laboratory mechanic, there must be a good reason to justify its use. The reason is simple—it is an effective teaching aid, and such aids are required now more than, say, twenty or thirty years ago. This need, of course, stems directly from the rapid expansion of scientific knowledge. If an instructor can find means to make learning easier, he can include some of the more recent methods of analysis without omitting the equally important items that belonged to the subject in the twenties. If he can not, then the ratio between what a student learns and what constitutes a working knowledge of the subject continually diminishes. Such a situation, of course, is embarrassing to teachers and disconcerting to employers.

To return to the description of the water tunnel, Fig. 1, each part has adjustable or changeable features. Thus, the headwater tank has a vertically adjustable overflow pipe so that it can function as a constant-level tank with a free surface or else operate as a pressure vessel when the overflow pipe is lifted and sealed (against an O-ring) at the top.

Further, the throat, ordinarily 3.6×5 in. in cross section, has a removable side that allows a converging-diverging nozzle to be slipped in. The nozzle constitutes a new and shorter throat in which cavitation will occur when the headwater tank is operated under sufficient pressure.

Finally, the diffuser, which is rectangular in section, is adjustable during operation. For convenience, in Fig. 2 the diffuser is shown expanding in a vertical plane. Actually, the adjustable walls stand vertically between a horizontal bottom plate of stainless-clad steel and a Lucite top plate. They are hinged at the middle, and each can be moved by long screws toward or away from the channel center-line. Thus this portion of the tunnel can assume a variety of symmetrical or unsymmetrical shapes, including a sudden expansion and a converging tube. In Fig. 1, the inner walls form a diverging tube while the throat portion contains a model wing-section.

Manometer Panel for Beginners

Because participation makes learning easy, students just beginning to study hydraulics operate the water tunnel and measure discharge rates and pressures. Therefore instruments and procedures are made simple and self-suggesting or self-explanatory. For example, a new squad is confronted with the manometer panel shown in Fig. 3. When the members of the squad turn on the water and get all the air bubbles out of the manometer leads (the instructor must insist on this), they see how the pressure head varies along the schematic tunnel drawn on a card and slipped

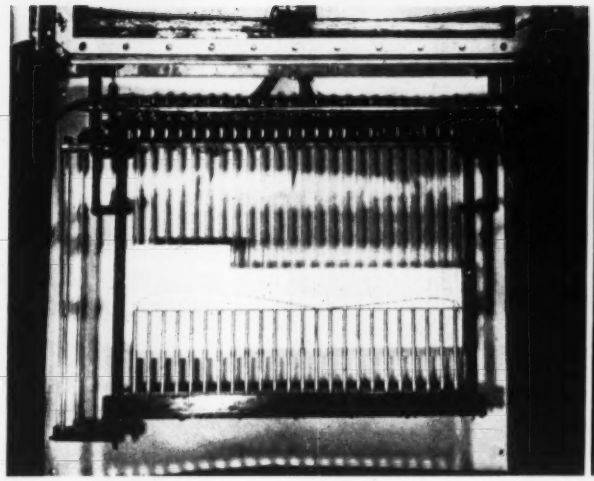


FIG. 4. Mercury manometer is seen ready for wing-section test. Water level in tunnel is just below wing-section, at top of photo, and all mercury columns read zero.

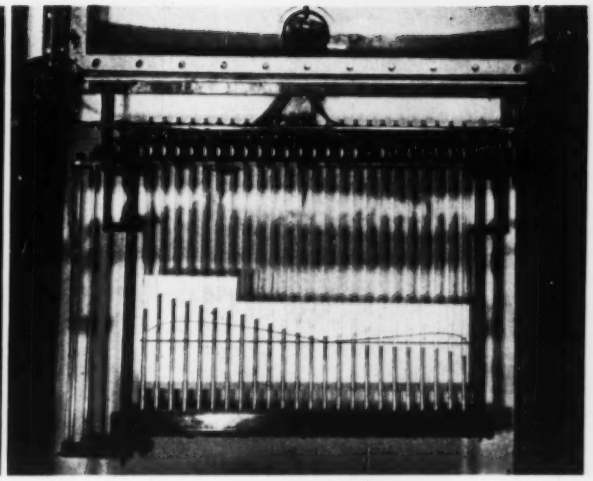


FIG. 5. Mercury manometer, during test, registers pressure changes. Depression of a mercury column indicates increase in pressure, while rise shows partial vacuum.

Hydraulic laboratory equipment . . .

Bernoulli principle

W. S. HAMILTON, M. ASCE

Professor of Civil Engineering, Northwestern University, Evanston, Ill.

behind the piezometers. The tubes are irregularly spaced so that they appear at the correct place on the drawing. A glance shows that where the section is small the pressure is low. Hence, because continuity requires that small sections have high velocity, regions of high velocity and low pressure become associated in the students' minds.

Further, the students see that the pressure at the end of the tunnel is less than in the headwater tank and readily accept the notion of friction loss. To impress these notions on their memories they measure the flow rate with the weighing tank, compute the velocity at various sections, and plot the manometer readings. Moreover, they change the angle of divergence, produce a sudden expansion, and answer questions on the relative amount of head loss for different configurations. Since the exit velocity will vary with the configuration, pressure drop alone is not a true measure of head loss, and the students usually must be prompted to give this matter a little thought.

As a second example, I should like to use the wing-section test, Figs. 4 and 5. The section is made of brass and has a chord of 3 in. For a prototype we selected a National Advisory Committee for Aeronautics foil on which extensive pressure measurements had been made in a wind tunnel. Within the limits of possibility, pressure taps were drilled in the brass model at the same relative points as in the prototype. Using a No. 80 drill, it was possible to get a total of 24 holes, each connected by its own brass tube and plastic lead to a mercury column. The mercury gage and the wing section itself are shown in Fig. 4, the latter at the very top of the picture. (Actually a larger throat section and a larger foil would be desirable if a greater discharge were available. The pressure holes and tubes are so small that clogging is a problem.)

The 24 pressure taps are identified by number on a sketch that is part of the instructions for this experiment. To provide an immediate impression of the pressure distribution around the foil, however, a slightly distorted sketch of the upper and lower surfaces is slipped behind the manometer tubes. The sketch was made, as shown in Figs. 4 and 5, as if the wing section were split in half along the chord and the lower piece placed behind the upper one. Thus, in the sketch, the larger portion (on the left) represents the upper surface with the leading edge at the extreme left, while the smaller portion represents the lower surface swung 180 deg from its true position—a procedure that puts the leading edge for this part at the extreme right. The connections then are made so that each mercury tube cuts the sketch near the point where it measures the pressure.

With no water flowing in the tunnel, the students and instructor fill the manometer leads with water and adjust the position of the sketch so that the chord is directly behind the tops of the mercury columns, as shown in Fig. 4. Then the flow in the tunnel is started and the mercury levels shift to an equilibrium position such as that in Fig. 5.

Once a student is told that a rise in the mercury indicates a suction, he notices that the suction on the upper surface is much greater than the positive pressure on the lower surface.

A squad running the wing-section experiment reads the mercury gage and measures the discharge. The members then must convert the gage readings into positive or negative pressure increments in feet of water and divide these values by the velocity head in the tunnel upstream from the foil. Each man plots the resulting pure numbers to show the dimensionless pressure distribution around the foil. He can then compare his graph with NACA wind-tunnel results.

Levittown, Pa., provides housing for industrial area

Sewage and water facilities built

ALFRED A. ESTRADA, A.M. ASCE, Principal Engineer and Vice President, Albright & Friel, Inc., Consulting Engineers, Philadelphia, Pa.

A city, by American standards, must have sewer and water service. In most American cities these utilities have been developed as a result of careful consideration extending over the past 50 to 100 years. In Levittown, Pa. (Fig. 1), a city of 60,000 people in the making, the time available for this careful consideration was not over 50 days. The credit for the progress made in this short space of time is due to Levitt & Sons, developers, who investigated, through their own engineering organization, through consulting engineers, and through the local power company, all phases of the utility requirements before an acre of ground was actually purchased.

Timing in the provision of utilities is of the greatest importance, for a housing unit does not become a livable dwelling until all utilities, including water and sewer, are available for use. The planning and construction of these utilities must keep pace with the construction of, and meet the date for the occupancy of, the first house.

On August 28, 1951, Albright & Friel Inc., were consulted by Levitt & Sons to determine the logical location for a sewage treatment works and its approximate cost to serve a population of either 30,000 or 60,000. After a preliminary study of the design, and consultations with the Pennsylvania State Health Department and officials of the Levitt organization, a plant of the activated sludge type, including digestion tanks and vacuum filtration, was adopted. The logical location of the plant was established and approximate cost figures were furnished to Levitt & Sons.

On October 15, 1951, the decision to proceed with the construction of Levittown was made by Levitt & Sons, and a target date for occupancy of the first house was set at May 15, 1952. This schedule allowed approximately 7 months to provide sewage treatment facilities. With nothing but preliminary ideas as to design, with firm bids still to be taken on the project, and with the Korean War affecting the equipment market, this schedule presented a serious challenge.

Time would not be available for the preparation of complete plans and specifications as required on a normal job. To expedite the start of construction, it was decided to prepare outline plans and brief specifications for use by bidding contractors. The bids had to be on a lump-sum basis for the completed project. The contractors were chosen for their past reputation and knowledge of sewage treatment works construction. In the preparation of bids, the contractors were expected to fill in, from experience, the details lacking on the outline plans. As a guide, complete drawings of similar construction were furnished to the bidders. The contractors were advised that complete detail plans would be furnished as these plans were available so that construction could proceed immediately upon a decision to award by the owner.

Alternate bids were requested for submission on November 14, 1951, for a complete treatment plant to serve 30,000, or to serve 60,000. Three bids were received, which varied less than 10 percent from high to low. This close bidding, together with the fact that extras on the completed project amounted to only 2.7 percent of the total cost, illustrates the successful coverage of construction scope by the bidding documents. As a matter of fact, more than half the extras on the job were brought about by subsurface conditions that were not apparent before construction started. It is important to note that the low bidder submitted a bid only 30 percent greater for the 60,000-population design than for the 30,000-population design, that is, a 30-percent increase in cost for a 100-percent increase in capacity.

On December 5, 1951, the contract was awarded to the low bidder, the R. M. Luff Construction Co., on the basis of a 60,000-population design. Construction started immediately and was scheduled so that the necessary yard piping, settling tanks, chlorinating facilities, and outfall sewer to the Delaware River would be ready for operation by May 1, 1952, which would afford primary treatment for sewage from the first houses to be occupied in the development. Subsequent stages in the construction of the project were established so that by December 1, 1952, the aeration tanks, final settling tanks, and control building could be placed in operation to provide complete treatment for the sewage. The final completion date was set as May 16, 1953.

The first stage of the project was completed and ready to receive sewage by the promised date of May 1, 1952, well ahead of the first houses, which were occupied late in May 1952. The sewage reaching the plant in March of 1953 was given aeration and secondary settling three months late, and the plant was substantially completed by May 1, 1953.

Other Problems Encountered

The major problem in the sewage treatment works project was, of course, the matter of timing, but other problems of a minor nature developed.

Careful coordination and cooperation between the operating per-

for a city in the making

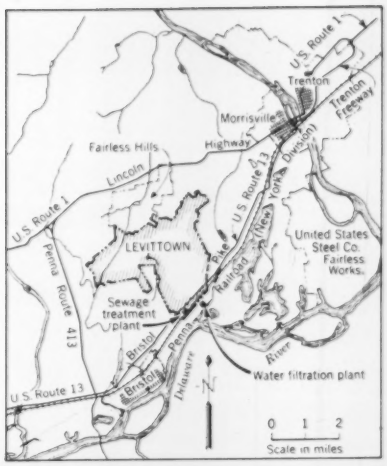


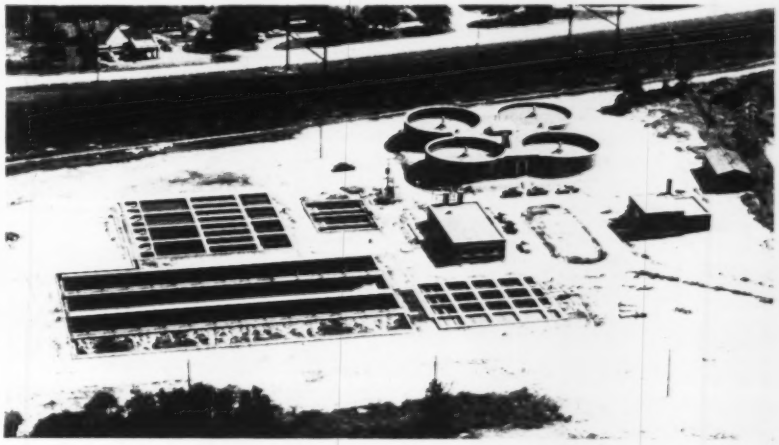
FIG. 1. Levittown, Pa., city with ultimate population of 60,000, is being constructed in period of four years. Locations of sewage treatment and water treatment plants for town are indicated.

sonnel and the contractor were required during the period when the primary plant was in operation and while the remainder of the plant was still being completed. Only one of the four primary tanks was placed in operation in May 1952, and the remaining primary tanks were used for sludge storage. This sludge was eventually transferred to the digestion tanks in February of 1953.

Construction of sanitary sewers, designed and laid out by the Engineering Department of Levitt & Sons under Clarence A. Monroe, A.M. ASCE, chief engineer, was completed in some parts of the development before grading. When grading was carried out in these areas, many manhole frames and covers were dislodged and an enormous quantity of earth found its way into the sewer system. Considerable quantities reached the treatment plant, clogging channels, and interfering with the operation of the sludge collectors. Levitt & Sons overcame this problem by doubling its inspection staff and by fining the grading contractors $50 for each manhole frame and cover dislodged.

A flow diagram of the sewage treatment plant is shown in Fig. 2. This plant is designed for a flow of 7 mgd of standard-strength sewage. It is estimated that this will be the average rate during daylight hours of operation when the housing development has been fully completed and occupied. The design loading for the various units is the accepted standard for sewage of average strength to reduce the organic pollution by 90 to 95 percent.

Sewage from the development collects in a main pumping station, located off the sewage treatment works site. This station is equipped with comminutors for shredding the sew-



Sewage treatment plant for Levittown, Pa., was completed, in first stage, well ahead of first houses in project. In air view, facing east, various facilities can be located from flow diagram below.

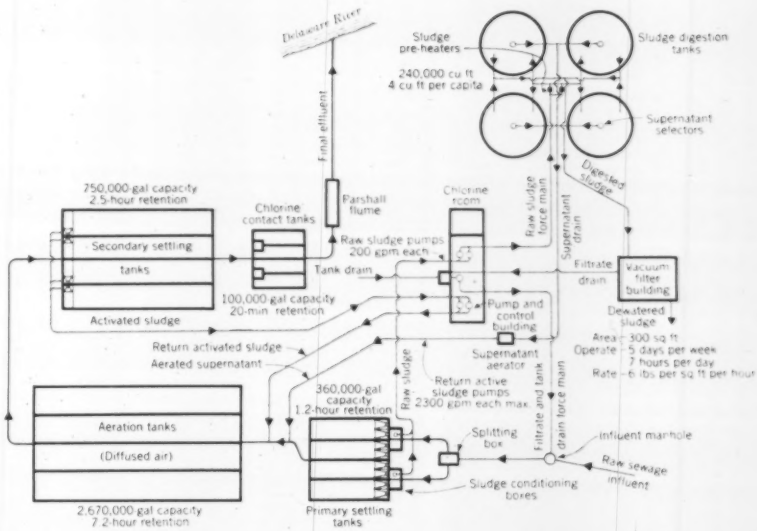
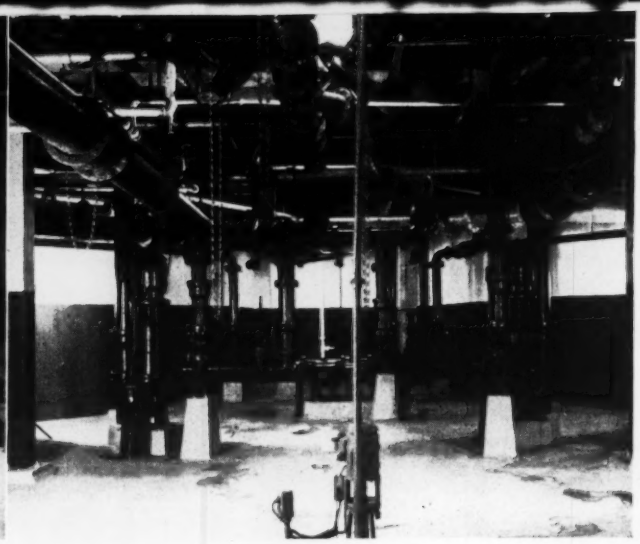


FIG. 2. Flow diagram shows facilities to treat sewage of 7 mgd, from population of 60,000.



Digester control building, on main operating floor (above, left), has supernatant gages and heat exchangers. Gas meter room is at right, out of photo. In basement (view at right) are sump pump, sludge transfer and recirculation pumps, control piping and valves.

age solids. Thence the sewage is pumped to a high-level sewer from which it flows by gravity to the Delaware River, through units of the plant which include the primary settling tanks, aeration tanks, secondary settling tanks, and chlorine contact tanks. Return activated sludge pumps having a capacity of 2,300 gpm are provided. This capacity is about 47 percent of the design influent rate of flow. Sludge digestion tanks, with a capacity of 4 cu ft per capita, and vacuum filtration for the handling of sludge are provided. It is planned to dispose of sewage sludge as land fill.

The more or less unusual features of the plant include:

1. A sludge supernatant aerator to reduce the oxygen demand on the supernatant from the digestion tanks before discharge to the head of the aeration tanks.
2. Aeration in all channels carrying mixed liquor to reduce the possibility of settling in these channels and subsequent septicity.
3. Provision of water sprays at the surface of the aerator to minimize the difficulties that have been experienced with foaming in tanks of this type caused by a low solids content in the mixed liquor and the presence of detergents.
4. Provision of three three-speed air blowers to supply air, which can be varied in quantity from 1,000 to 5,000 cfm, increasing in increments of 500 cfm, so that the operator can adjust air quantities to suit oxygen-demand requirements.
5. Installation of a coil-spring filter with a continuous wash on the coil springs after filtration to keep the unit at its maximum filtration capacity at all times.

At present about 5,000 houses are connected to the sewer system, of the total of 16,000 in the ultimate development which it is anticipated will be completed by 1955. At present, therefore, only about one-quarter of the ultimate load is being received at the plant, and the operational data are so meager that I do not feel they are suitable for presentation.

Water Treatment Plant Under Construction

On December 20, 1952, or 15 months after the start of construction of the housing project, we were called into consultation on the problem of water supply for Levittown. At that time, six wells of 20-in. diameter were in operation at a site adjacent to the Delaware River which formed a river infiltration gallery. The original design contemplated a capacity for each well of 1.5 mgd, with 4 additional wells to be drilled in the future. This capacity had been estimated from one pilot well installation. In view of the proximity of the infiltration bank to the river, it was originally thought that these wells would not affect one another in their yield. Unfortunately, once they were completed and yield tests run, the average safe yield when they were operated together, was established to be less than 1 mgd each, with a probable decline to 0.7 mgd, or a total yield of about 4 mgd from the 6 wells.

Comparative cost studies were made for providing additional infiltration galleries of the Ranney type as against the provision of a filter plant to supplement the existing well capacity. The ultimate water requirement was set at 12 mgd.

Provision of infiltration galleries, although it would entail the purchase of expensive land, worked out to be cheaper than the cost of constructing a complete 8-million-gal filter plant. However two unknown factors would still remain—the possibility of interference and that of decline in yield due to silting of the infiltration bank. With these factors in mind, Levitt & Sons decided to construct the 8-million-gal filter plant and be assured of a safe quantity of water. As a hedge against the possibility of a further diminution in the supply from the existing infiltration gallery, we were instructed to design the plant for possible expansion in the near future to 12 mgd.

Provision of the infiltration gallery to secure an immediate water supply in the early stages of the housing development proved to be of great value for the following reasons:

1. It would have been impossible to construct a filter plant in the seven months that were available between the date when it was decided to proceed with construction of the development and the date when the first house was to be occupied.
2. The 4-mgd safe yield, which it is estimated will probably be available from the existing infiltration gallery, is "cheap water" as compared with that from a filter plant.

Timing in the provision of the additional water supply through the filtration plant was again of paramount importance because it was estimated that the present infiltration gallery would be completely overwhelmed by the demand by May 1954, when it was estimated that the housing development would have grown to 30,000 people, and when peak water sprinkling demands on the distribution system could be expected.

On February 9, 1953, we were instructed to complete the design of the water treatment plant and prepare to take bids on its construction. The same procedure in select-

ing bidders and furnishing outline drawings was followed as for the sewage treatment works, and bids were taken on April 7, 1953. In this case, there was a spread of approximately 15 percent in the five bids received, and only 4 percent in the three low bids, indicating that all bidders were fairly well informed on what was expected. The contract was awarded to the Vanguard Construction Co. on April 16, 1953, and work started April 27, 1953. Completion is scheduled for June 1954.

Construction is at present on schedule even though some difficulties have been experienced with the delivery of pipe, which had been ordered from a foundry whose employees were on strike for two weeks.

The arrangement of the water supply and treatment facilities is shown in Fig. 3. The existing six infiltration wells are located along the bank of the dredged gravel pit. The water to be treated is taken from the Delaware River in a 36-in. gravity line to a low-lift pumping station which pumps it to the treatment works. This pumping station will be equipped with a traveling water screen and two 8-mgd vertical-turbine-type pumps, with provision for a third pump in future.

The treatment plant (Fig. 4) is of the conventional type with flash mixers for premixing the lime and alum; slow mixing tanks equipped with variable-speed horizontal paddles; settling tanks; and four 2-mgd filters. The clear well is located under the filter units.

The more or less unusual features to be incorporated in the plant include:

1. The semi-automatic rate-of-flow control through the plant is governed by the high-duty pumping rate. A manual change in the capacity of the high-duty pumps will start a chain reaction of control back through the clear-wall level, automatically controlling the rate of flow through the filter and changing the level of the water in the settling basins, which will automatically control a butterfly valve in the low-duty force main thereby controlling the quantity of water delivered by the low-duty pump then in service.
2. Chlorine-dioxide equipment and carbon feeding equipment will be provided for taste and odor control.
3. The arrangement of the clear well will allow cleaning of alternate partitions of the well while the plant is still in operation.
4. The units are compactly arranged and there is provision for expansion to 12-mgd capacity. The flash and slow mixers are being constructed for 12-mgd capacity, and a settling basin and two 2-mgd filters can readily be added to the plant.
5. Surge-suppression equipment is being provided to minimize water hammer in the discharge piping from high-duty pump operation.
6. The high-duty pump piping is so arranged that in the event of a break in any fitting or valve in this piping system, sufficient high-duty pumping capacity can be maintained in operation to provide 8 mgd.

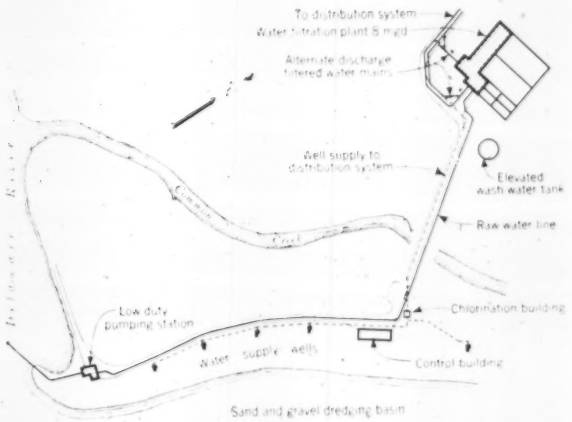


FIG. 3. Filtration plant takes water from Delaware River to supply 8 mgd, with provision for expansion in near future to 12 mgd. This is in addition to 4 mgd developed initially from six wells in river infiltration gallery in foreground. (One well is in Control Building.)

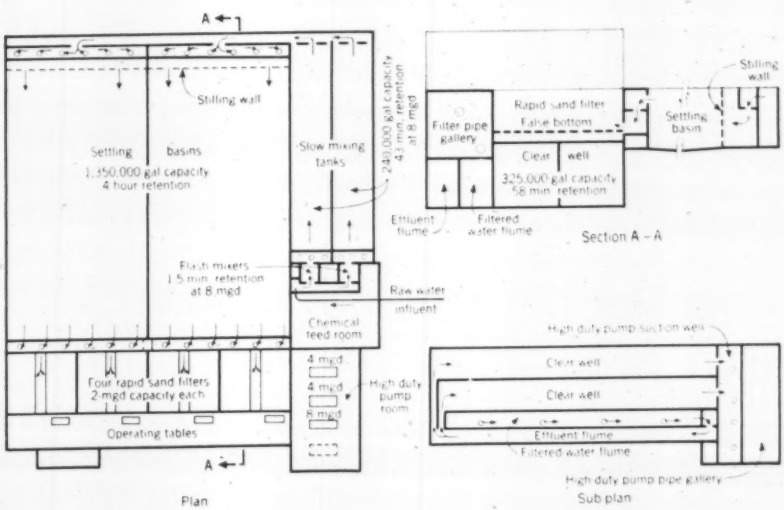


FIG. 4. Flow diagram indicates arrangement of conventional-type water filtration plant which has flash mixers for premixing lime and alum; slow mixing tanks with variable-speed paddles; settling tanks; and four 2-mgd filters. Flash and slow mixers have 12-mgd capacity, and another settling basin and two more filters can readily be added to give full 12-mgd capacity.

The provision of utility plants as extensive as these for a housing development is unique. And, as a matter of fact, the entire development is unique considering that a good-sized city is being constructed in the short space of a little over four years. The most unusual part of the project, as I see it, is the fact that this city, together with the extensive steel plants nearby, was born as a result of the discovery of one of the world's richest deposits of iron ore in Venezuela, by a then unknown geologist named Folke Kihlstedt, in 1947. It was this discovery which led to the decision of the U.S. Steel Corporation to build a steel plant in this area.

ENGINEERS' NOTEBOOK

Pneumatic pillow replaces sand bags for dead-load testing of

E. A. MILLER, A.M. ASCE, Manager, Building Products Division, Detroit Steel Products Company, Detroit, Mich.

Successful integration of a lightweight steel frame, an elementary pneumatic circuit, and a unique pneumatic pillow at the Buffalo testing laboratories of Detroit Steel Products show that "home-made" apparatus can be constructed that is practicable and, in fact, desirable for testing the relative strength of structural elements.

Not only is the accurate performance and operating ease of the machine impressive; it is extremely simple and flexible in design, is economical to build and can be constructed by plant personnel. See the accompanying photograph and Figs. 1 and 2.

Inadequacy of conventional test methods prompted the development of the machine by the Detroit Steel Products engineering and research department. Determination of elastic limit, web crippling point, failure and other characteristics of Fenestra panel building sections was largely a matter of loading and unloading sand, sand bags, scrap steel, concrete block, or similar substances. This method, although yielding the desired data, was time-consuming, back-breaking, and not always accurate. As the company expanded its experimental activities with light-gage steel panels, testing became a real problem. The necessity for more testing made the cumbersome load sets a bottleneck. Simultaneously, structural innovations required greater accuracy, which meant better uniform loading and smaller load increments than was possible with sand bags.

Available hydraulic testing machines which could have been adapted to the purpose, were prohibitive in cost in proportion to the testing required. Consequently development of a special testing machine became an urgent engineering project. The specifications laid down for the machine were challenging. To be worth while, it was felt, it had to be able to:

1. Handle test specimens up to 16 ft in length.
2. Handle test areas up to 6 ft in width.
3. Apply concentrated loads simultaneously at any points on the specimen.
4. Apply uniformly distributed loads over the test area.
5. Apply loads in small, simply controlled increments.
6. Apply loads up to three times the floor loads normally encountered for panel-type construction
7. Give high accuracy in the application and measurement of loads.

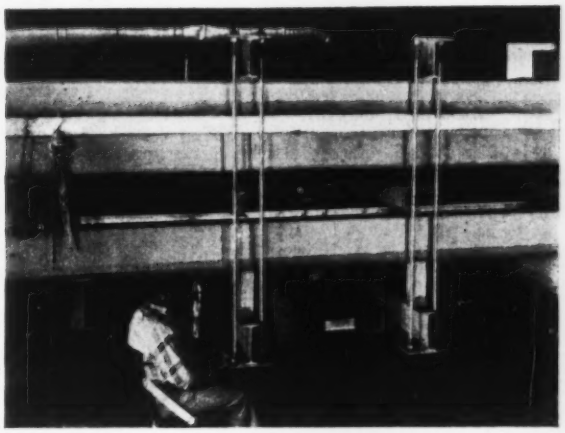
Design Features of Tester

The tester is composed of three fundamental parts: frame, loading device, and instrumentation for measurement.

Frame. The four-legged frame is made of light structural steel members welded together to form a rigid support. Approximate overall dimensions of the frame are: $17\frac{1}{2}$ ft long, 7 ft wide, and $8\frac{1}{2}$ high. The clear-span distance between structural members is 16 ft 0 in. in length and 6 ft 0 in. in width. The members holding the pneumatic pillow are 6 ft $6\frac{1}{2}$ in. above the floor line. Two side structural members, about 4 ft above the floor line, provide flanges for two I-beams which are clamped at right angles to the structural members. These I-beams provide the bearing surface for the test specimens. The clamping arrangement permits adjusting the distance between I-beams to accommodate any length of specimen. The specimen can be adjusted vertically by stacking additional beams on the bearing surface.

Loading device: The loading device consists simply of an 18-gage stiffened sheet-metal cover plate with a fabric balloon attached to the plate and extending below it. The balloon fabric is two-ply, Neoprene-impregnated, supplied by Goodyear. The balloon measures 17 ft long by a little more than 8 ft wide, deflated. Piping through the top of the cover plate provides compressed air for inflating the balloon, which then becomes a pressure sack acting as the load for testing. This same piping has a valve leading to a pump motor, which is used to remove all air from the sack on completion of the loading cycle.

Instrumentation: Two separate gages are used to facilitate reading of loads applied. A water manometer is used to read loads in 1-psf increments up to a total of 100 psf. A mercury manometer is used to read loads in 5-psf increments between 100 and 400 psf. Both manometers are hooked up to the air sack by piping through the sheet-metal cover plate. To measure specimen deflections, company engineers devised special gages



Pneumatic testing machine is seen set up for test, with platform load applied at one-third points of span. Strain and deflection gages are in position for test.

resembling small hand weight scales. These gages are graduated in $^{1}/_{100}$-in. increments, but by interpolation an accurate reading is possible from $^{1}/_{1000}$ in. up to 6 in.

Operation is simple

Operating the pneumatic tester is an easy matter. The bearing beams are adjusted to the distance required to hold the specimen and then clamped. The specimen is loaded by means of a small chain hoist. When the specimen has been placed on one of the bearing beams, it is manually moved until it rests in the desired position. The condition of test loading determines the exact procedure followed for placing the specimen.

Uniformly distributed load. Under this condition, the specimen must come in direct contact with the pneumatic pillow, which is accomplished by adjusting the height of the specimen on the bearing beams.

As the sack fills, its pressure is applied uniformly over the entire test specimen. The oversize bag fills out, providing contact area throughout, with the exception that as deflection increases there is a perimeter effect to be considered. Curves evaluating this effect have been developed for ready reference. In the testing of such large areas, however, it is of negligible significance.

Concentrated loads. In this case there is usually no need to adjust the test specimen above the bearing beams. Concentration of a load on specified points of the test specimen is

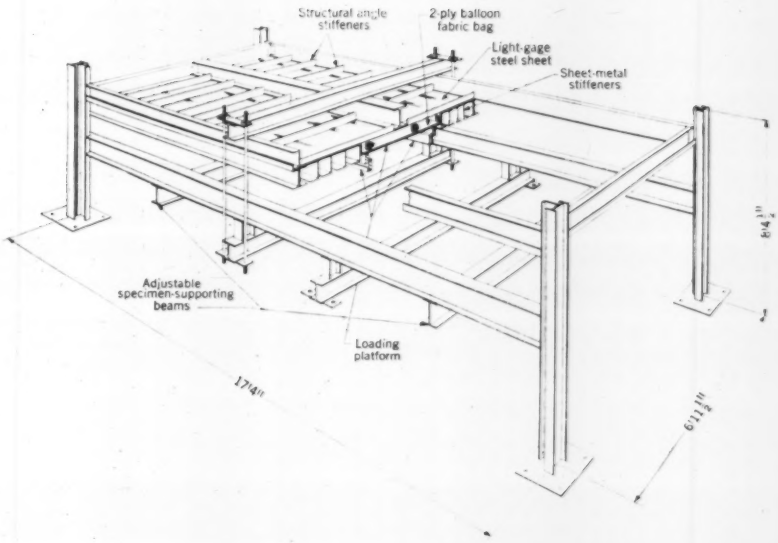


FIG. 1. Perspective view of pneumatic testing machine shows adjustable specimen supporting beams which allow testing of specimens of different lengths.

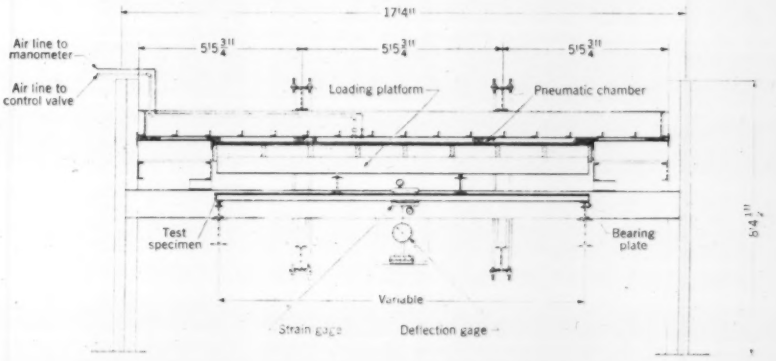


FIG. 2. Longitudinal section has specimen in place, showing method of support, method of loading at third points of span, and location of strain and deflection gages.

accomplished with a wood-frame steel-stripped platform and a simple network of cross members. The platform serves to transfer the balloon load to the cross members which, in turn, deliver the load to their respective contact areas. The platform can be adjusted to take up small differences in the depths of test specimens. The cross-member network can range from a simple two I-beam setup for two-point testing to special rigs of right-angle sections for multiple point loading.

Under both load conditions, the practice is to mount four deflection gages at the bottom of the specimen and strain gages on tension and compression sides. Actual operation of the machine during test involves nothing more than valve manipulation guided by manometer and gage readings.

The air intake piping comes off the plant's regular compressed-air line, on which pressures are at 80 to 100 psi, more than enough for test pur-

Restraining-force method of calculating slope and deflection

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In present methods of finding the slope and deflection of a beam or continuous structure, either rigorous computations of moment areas or long evaluation of integrals are involved. The restraining-force method presented here is easy to apply and has the important advantage of avoiding the calculation of moment areas or integrals.

Actually, the method involves only the moment-distribution method plus some operations of simple statics. However, it provides a convenient solution to the problem of determining the slope and deflection of simply supported beams, continuous beams, or rigid frames with comparatively complicated loading systems, and has shown itself to be a useful tool in modern methods of analysis.

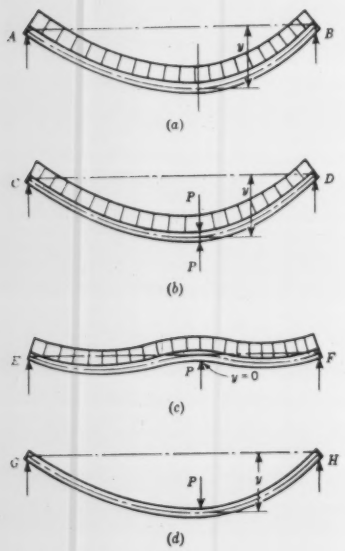

FIG. 1.

Finding Deflection

The beam AB, shown in Fig. 1 (a) has the same internal stresses and similar elastic curve as the beam CD shown in Fig. 1 (b). It is seen that the beam CD is the same as the beam AB except that two equal but opposite loads, P, are applied at a certain point. The value of P can be chosen to satisfy any assigned condition.

By the principle of superposition, the beam CD can be considered as the beam EF in Fig. 1(c) plus the beam GH in Fig. 1(d). Now, if the magnitude of P in beam EF is so chosen that the deflection at the point of application is zero, then the deflection y in beam GH at that point is the deflection of beam AB at the corresponding point. Hence, in determining the deflection at a certain point in a beam, the procedure is as follows:

1. Put a restraining force P at the point where deflection is desired to prevent any motion of that point.
2. Find the value of P by using the moment distribution method as shown in examples.
3. Assume any value of y in beam GH and find P in terms of y. As the value of P has already been obtained, y can be calculated directly.

Consider a beam AC, with the mid point B, which, after the restraining force is applied, becomes a continuous beam of two equal spans. The distribution factors at the joint are 0.5. The fixed-end moments at point B are easily found from any handbook as 100 kip-ft and -106.3 kip-ft, and the final moment is 103.15 kip-ft. As the shear V_{BA} is 40.315 kips, and V_{BC} is 40.315 kips, the force necessary to keep point B from moving is equal to 80.63 kips, and is acting upward.

Next consider a force P applied upward at B, in terms of deflection y. The fixed-end moment at point B due to the deflection y is obtained from Fig. 2(a).

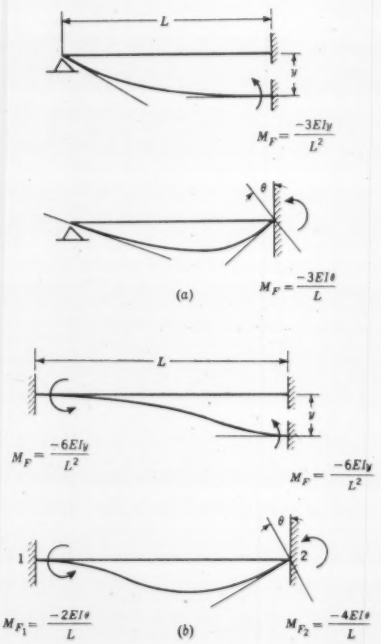

FIG. 2.

poses. In fact, only about 3 psi is required for a loading of 500 psf.

When the particular loading cycle is complete, the air intake valve is closed, and the air in the sack leaves through the open air valve in the exhaust branch of the air circuit. In deflating, the sack cannot force all the air out. Actually about 10 psf remains. Then the pump-motor valve is opened, and this motor completely deflates the sack. The entire unloading cycle takes about 5 minutes.

The reliability of the machine has been excellent. When checked with proving rings by the Pittsburgh Testing Laboratories and Baldwin Locomotive, it has shown an accuracy within 1 percent. It has been a simple matter to adjust for this variation through performance curves.

Maintenance requirements of the machine have proved to be very low. The pneumatic pillow, which cost about $1,000, is still in good condition after more than 10 years of service.

Since the fixed-end moments are equal to each other, they are the end moments in the members, and the force P is found to be $6EIy/10^3$ acting downward.

To remove the restraining force, it is obvious that $6EIy/10^3$ should be equal to 80.63, and accordingly, the value of the deflection y is determined as shown in the example for deflection, which follows.

Example for Deflection

Find the deflection at point B of the simply supported beam AC, loaded as shown in Fig. 3.

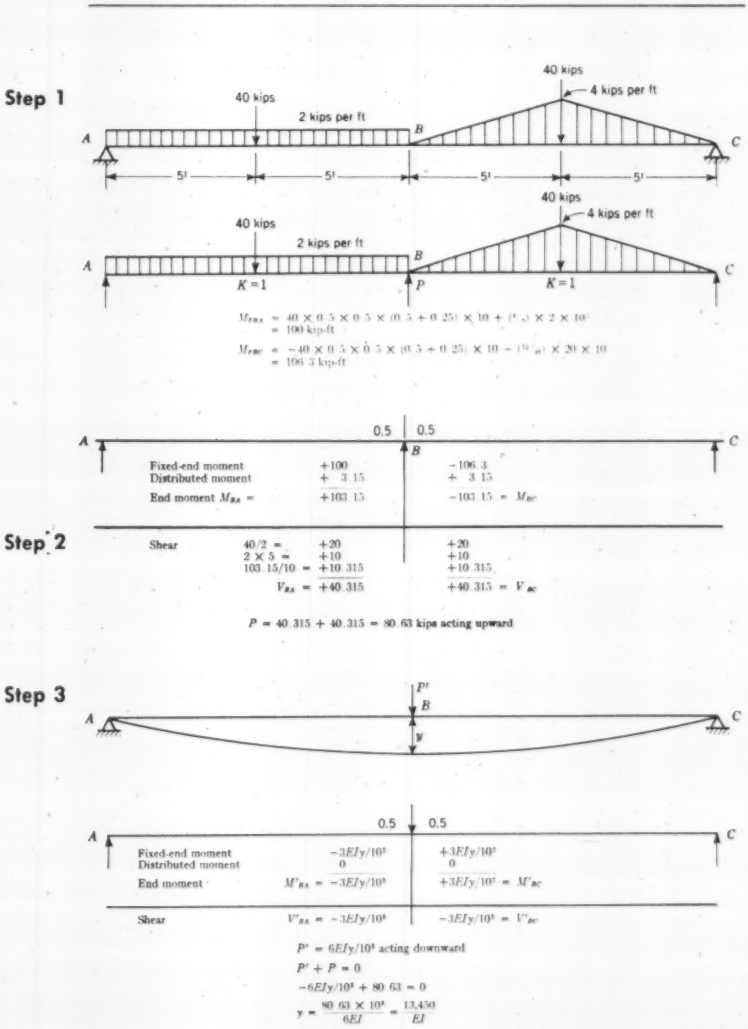
Step 1
40 kips
2 kips per ft
40 kips
4 kips per ft
A
B
C
5'
5'
5'
5'
K = 1
P
K = 1
M_{BA} = 40 × 0.5 × 0.5 × (0.5 + 0.25) × 10 + (1/2) × 2 × 10³
= 100 kip-ft
M_{BC} = −40 × 0.5 × 0.5 × (0.5 + 0.25) × 10 − (1/2) × 20 × 10
= 106.3 kip-ft
0.5
0.5
Fixed-end moment +100 −106.3
Distributed moment + 3.15 + 3.15
End moment M_{BA} = +103.15 −103.15 = M_{BC}
Step 2
Shear 40/2 = +20 +20
2 × 5 = +10 +10
103.15/10 = +10.315 +10.315
V_{BA} = +40.315 +40.315 = V_{BC}
P = 40.315 + 40.315 = 80.63 kips acting upward
Step 3
P'
B
y
0.5
0.5
Fixed-end moment −3EIy/10³ +3EIy/10³
Distributed moment 0 0
End moment M'_{BA} = −3EIy/10³ +3EIy/10³ = M'_{BC}
Shear V'_{BA} = −3EIy/10³ −3EIy/10³ = V'_{BC}
P' = 6EIy/10³ acting downward
P' + P = 0
−6EIy/10³ + 80.63 = 0
y = 80.63 × 10³ / 6EI = 13,450 / EI

FIG. 3.

Finding Slope

By the same reasoning used for deflection, the slope can be found.

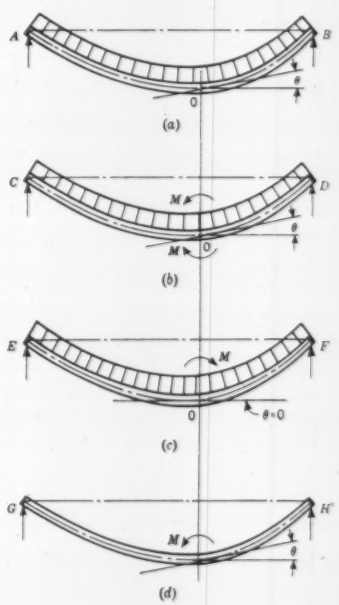

FIG. 4.

Beam CD in Fig. 4(b) can be considered as beam EF in Fig. 4(c) plus beam GH in Fig. 4(d). If the magnitude of M in beam EF is so chosen that the rotation at the point of application is zero, then the rotation θ in beam GH at that point is the slope of beam AB at the corresponding point. Hence, in determining the slope at a certain point in a beam, the procedure is as follows:

1. Since M is assigned to keep θ from being rotated, beam EF can be considered as two beams EO and OF, with full restraint at point O. Then find the fixed-end moments in each beam, and M is the sum of the two fixed-end moments.
2. Apply M in the reverse direction and find its value in terms of θ. Since the numerical value of M has already been obtained, the value of θ can be determined.

Example for Slope

Find the slope at point A of the simply supported beam AB loaded as shown in Fig. 5.

Step 1

The moment M_{FAB} necessary to keep point A from rotating is obtained by $-(1/15)\ wL^2$ for the triangle load ABA' plus $(5/64)wL^2$ for the triangle $AC'B$.

$$M_{FAB} = (-1/15)(1.2)(20^2) + (5/64)(0.2)(20^2)$$
$$= -32 + 6.25$$
$$= -25.75 \text{ kip-ft}$$

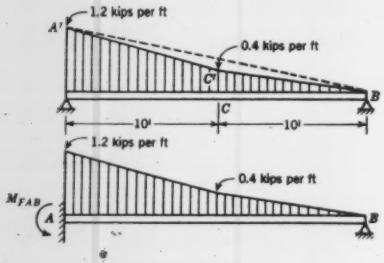

FIG. 5 (a)

Step 2

The moment M'_{FAB} necessary to rotate point A to an amount θ_A, from Fig. 2(*a*), is

$$M'_{FAB} = 3EI\theta_A/L$$
$$M'_{FAB} + M_{FAB} = 0$$
$$3EI\theta_A/L - 25.75 = 0$$
$$EI\theta_A = (25.75) \times (20/3) = 171.5$$

FIG. 5 (b)

Finding Maximum Deflection

The position where maximum deflection occurs can be explicitly established by following Step 1 in the example for slope. In this step the unbalanced moment is found as the sum of all the fixed-end moments at the point. If the unbalanced moment vanishes, then it means the true rotation at that point is zero and accordingly it is the point at which maximum deflection is produced. However, this location is to be found by the method of trial and error, which fortunately converges rapidly in this case.

This method is generally applicable and may be applied to simply supported members of non-uniform section modulus, I, and also to continuous beams. Limitations of span, however, make it impossible to illustrate the solution of these types of problems here.

THE READERS WRITE

Earth's Rotation Has Little Effect on Vortex Motion

TO THE EDITOR: In their article, "Vortex Motion in Viscous Fluids Studied in Apparatus Consisting of Concentric Glass Cylinders," in the September issue, page 51, Messrs. Einstein and Li state that "the earth's rotation is often sufficient to create violent vortexes," and that "this whirling motion. . .defies almost all attempts at suppression." This viewpoint has been widely held, but recent quantitative tests have shown that it is incorrect or grossly exaggerated, to say the least.

In most cases the moment of momentum resulting from the earth's rotation is so small that vortexes resulting solely from it are barely perceptible, and have no measurable effect on the discharge. The idea that the vortex, once started, may "feed" upon the head and grow to serious proportions is a fallacy since energy is not convertible into moment of momentum, per se.

Tests show that the strength of the vortex and its effect on the discharge depend upon whether the velocity of approach has components which are tangential relative to the outlet. (*Engineering News-Record*, March 9, 1950, p. 30.) If the approach velocity is strictly radial, no appreciable vortex will form.

It is true, however, that it is often difficult to predict whether the approach velocity will be radial. At the recent open meeting of the Society's Hydraulic Research Committee at Minneapolis, Pierre Danel, director of the Neyrpic Laboratories, cited the following example. The walls are symmetrical approaching an outlet, but diverge. If separation does not occur, the approach velocity will be largely radial and no strong vortex will form. But if separation occurs, the high velocity flow may hug one side or the other through the diverging section, and a strong vortex will form which will persist in its direction of motion, which may be either right hand or left hand. If the symmetry has not even a slight defect, the earth's rotation may make one of these a little more likely to form than the other, but it will not cause one which becomes started the "wrong way" to reverse, or measurably affect its strength after it has fully developed.

In perfectly symmetrical approaches, without flare, the inequality of velocity distribution due to friction almost always causes vortexes—usually a symmetrical pair, but only in unusual cases do they have an appreciable effect on the discharge.

An outlet near the center of a large reservoir could theoretically develop a strong vortex from the earth's rotation if the water, initially a great distance away, were drawn to the center without suffering any diminution in its vorticity, the vortex strength varying with the square of the ratio of the diameter of the reservoir to that of the outlet and with the square root of the depth of the water. In most actual reservoirs, the dissymmetry of the approaches will prove to have a greater effect.

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Iowa City, Iowa

Purchasing Services Versus Hiring Employees

TO THE EDITOR: Do you hire an employee or do you purchase the services that person can render? There is a vast difference—the difference between making or breaking your business; the difference between high and low morale, between teamwork and strikes, disputes and labor unrest; the difference between high and low production and between high and low costs.

As an employee do you work *for* your employer on a servant-to-master basis or *with* your employer on a basis of equality, rendering the services he has purchased, as a matter of good business? Again there is a vast difference—the difference between living and existing, the difference between a pleasant job and a sour job, the difference between stability and unrest, the difference between being somebody or just a name and number on the payroll.

Pride is such a basic factor in a person's own life that he is very likely to become so self-centered that he fails to realize that pride is equally important to everyone else. Pride of accomplishment, pride of ability, pride of equality and social standing, pride of ownership, pride of running the race and rivalry are all basic things which make us tick and likewise make the other fellow tick.

Every individual has two things the employer pays to receive—these are skill and energy. Energy, as applied to the skill of knowledge and ability, begets production. Anything which tends to limit or decrease this energy or the skill to which it is applied

decreases the individual's production. Conversely any factor which increases the individual's energy and skill increases production.

In our American way, the individual releases this energy and applies it to his skill from within, voluntarily and because he wants to. He will cooperate willingly and give generously of his energy and skill if treated as an equal under conditions which will generate pride. When forced under conditions which decrease pride, he will give out grudgingly because of necessity. Therein lies the difference between the "want to" psychology and the "have to" psychology. Pride is the key.

The high road of forced production through fear psychology has certainly not resulted in labor peace and harmony or the reaching of the most desirable goals of production. Experience has shown that the low road of paternalism in any form, no matter how generous, does not pay as it considers the employee a welfare case.

The middle road is, therefore, a good business basis which treats the employee as an equal. He has services in the form of energy and skill which the employer desires to purchase. He takes pride in an across-the-table dealing—the pride of recognition, the pride of accomplishment, the pride of rendering full measure for each dollar received. Under these conditions, job morale and production will increase and costs drop.

The projection and connotations of the principle "that you don't hire an employee, but rather purchase the services that person can render," is the basic answer to our American labor economy.

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Construction and Hydraulic Engineer
Washington, D. C.

Engineers Urgently Needed in the Middle East

To the Editor: Engineers of all types are urgently needed in the Middle East. Lebanon, Syria, Saudi Arabia, Jordan, and Egypt have so much work on their hands, thanks to the U.S. Point 1V and the Ford Foundation, that they don't know which way to turn. With Aramco, the Iranian Oil Company and several independent companies working like mad to install pipe lines, administrative buildings, etc., there is so much engineering work to be done that the supply comes nowhere near equal to the demand.

My specialty is geodesy, that is, furnishing accurate control, both horizontal and vertical, for maps. There is a decided need for accurately controlled maps in this section of the world. The maps which are available at the moment are no more than reconnaissance sketches. A geodesist can name his own price for a few years' work.

An engineer going to that section of the world must be able to withstand climatic changes, which are hard to take. With a cold wind off the mountains one day and a warm, humid breeze off the Mediterranean the next, rapid adjustments are necessary. I couldn't take it myself and was hospitalized twice in one month with pneumonia.

Medical facilities are excellent, although expensive. Hospitalization expenses are about as in the States. Modern antibiotic medicines are cheaper than in the States and X-rays are much cheaper. The reason I mention these things is that sooner or later everyone comes down with one or the other of these tropical diseases, and will find himself under treatment.

Outside of Beirut, Lebanon and Damascus, Syria, it is essential to drink nothing but boiled or bottled water. The native vegetables are rank poison, and I know of no better route to the hospital than to try a green salad. Fruits are O.K., and can be eaten without danger. Meats, aside from lamb, should be looked upon with jaundiced eyes. Poultry is as safe as in the States; eggs, of course, can always be eaten.

The distaff side of the house will get a great kick out of shopping, once she learns to dicker. While there are a few "one-price" shops, the great majority are of the type where you price something, tell the clerk he wants too much and walk out. Chances are he will follow you to the sidewalk and ask what you want to pay. You mention a price ridiculously low. He comes down, you come up, and eventually you reach a price mutually satisfactory.

Despite the pessimistic tone of this letter, I was and am very interested in this section of the world, and were I some 25 years younger, I can conceive of no more interesting work than to go there for a few years.

Anyone interested will be given further details upon request. The travel involved, the historic countries visited, the problems which must be solved are all worth while.

To any one who tries it, good luck and bon voyage!

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Editor's Note: *This letter appeared originally in the July 1953 News Letter of the Texas Surveyors Association, Austin, Tex.*

Pile Test Programs Pay Big Dividends

To the Editor: I have read with interest the article on Pittsburgh's Gateway Center by Messrs. Di Stasio and van Buren in the September issue. Of particular interest to me were the remarks and photographs concerning the load testing of steel H-piles that had been driven to rock. Since no information was given in the article concerning the final resistance to which these piles were driven or the hammer used, it is presumed that these tests were performed to ensure that the piles actually were seated on rock and had not stopped on some material of lesser bearing capacity. These tests showed that the piles could carry the design load with a factor of safety of at least 2, but did not reveal the actual capacity of the piles, which would have been of interest.

The testing of piles driven to rock or to a resistance determined from a formula for the required bearing capacity, at sites where rock is not the supporting stratum, is common practice. Such piles are frevuently loaded to $1^1/_2$ to 2 times the design load, and the pile is considered to be satisfactory when the movements under these loads do not exceed a few thousandths of a foot. Such a test does not achieve the full value from the money spent, since it does not establish how oversafe the pile is and therefore does not indicate what actual length of pile is required to carry economically the load at the required factor of safety. It is well known that the driving formulas do not give this true length and do not give a consistent factor of safety. Therefore their use is not economical, nor does it allow the designer to know, even approximately, how safe the foundation is.

I advocate fully the use of pile load tests, but if they are to be performed, the cost of running them must produce positive, useful results that can be used to determine an accurate design. Otherwise they had better not be run at all as their cost is not justified. If tests are to be made, a series of piles should be driven—three is usually enough—to different depths or resistances, using the same equipment that is to drive the structure piles on the job. Carefully controlled tests should then be made and each pile should be brought to failure. This is very important since only then can the ultimate capacity of each pile be determined and the necessary corrections for group action and factor of safety be applied to determine the safe bearing capacity of the pile. When such information has been obtained for a series of piles, then and then only can the most economical pile length, etc., be determined. The capacity of a pile foundation is dependent upon so many factors that do not enter into the formula that the engineer owes it to himself and his client to protect both their interests by means of carefully designed and executed pile-test programs.

On two recent jobs with which I was connected, such test programs paid big dividends to the owner by reducing the pile lengths that would have been required if a driving formula had been used. But more important was the fact that we knew what we had in the way of capacity and factor of safety in the foundation.

Finally, I would like to draw attention to the arrangement used for producing the reaction for the tests conducted in Pittsburgh. While the "boot-strap" type of test is economical for the testing of most piles, one of its essential features is that the reaction piles must be far enough from the test pile so as not to influence this pile in any way. The reaction piles shown on the test illustrated in the article appear to be somewhat close to the test pile. Since the test was performed to ensure that the pile was seated on rock, the effect of this apparently close spacing would not be significant. However, the reader should bear in mind that for tests on piles not driven to rock a greater spacing between the test piles and the reaetion piles would be desirable.

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Soils and Foundation Engineer
Knappen-Tippetts-Abbett-McCarthy
New York, N. Y.

SOCIETY NEWS

Merry Christmas and a Happy New Year

Atlanta City Hall is one of the many impressive downtown structures.

Typical of the projects being built in the increasingly industrialized South are two Corps of Engineers dams in the Atlanta area—Buford Dam (lower left view) which is now under construction, and Allatoona Dam (lower right) which is now in operation. Trips to these projects are on the agenda for engineers attending the Atlanta Convention.

Outstanding Program Planned For ASCE Atlanta Convention

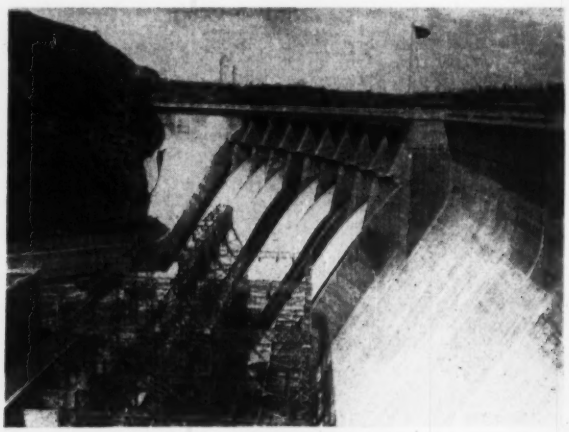
There are a number of compelling reasons for attending the Society's Atlanta Convention, February 17–19, apart from the projected program of 22 Technical Division sessions and of inspection trips to recent projects important in the new industrial South. For one reason, Atlanta in February will offer an interlude of springlike weather that should be welcome to visitors from colder parts of the country. For another, Atlanta is the heart of an area rich in historical interest and the traditions of the Old South. As "the Convention City of Dixie" and the metropolis of the Southeast, Atlanta offers every facility for an interesting and comfortable stay, and the Atlanta Biltmore, Convention Headquarters, is one of the city's finest hotels.

Of Interest to Engineers

For the visiting engineers, field inspection trips are being arranged to two Corps of Engineers projects—Allatoona Dam, which is now in operation, and Buford Dam, which is under construction. Convenient to the Convention headquarters are the Atlanta waterworks with its huge expansion program and the new Atlanta Expressway system that will offer a chance to study the vast construction problems arising in the relocation of large downtown areas for a superhighway system. Other tours will provide an opportunity to inspect new manufacturing plants.

Sightseeing Ranks High

For all guests, special tours have been arranged to the Cyclorama and Stone Mountain. A historic painting of the Battle of Atlanta, the Cyclorama commemorates the events that sealed the fate of the Confederacy. It is on exhibition in a special building of its own in Grant Park. The Stone Mountain Confederate Memorial, located 16 miles east of Atlanta, is the largest solid body of exposed granite in the world. A veritable mountain of stone, it is 800 ft high, seven miles around the base, and a mile to the summit up the sloping side.



Varied Social Program Planned

With typical Southern accent on hospitality, committees of Georgia Section members are planning a social program that should appeal to all tastes. The events will include an opening-day luncheon, which will be addressed by Governor Herman Talmadge of Georgia; a get-together and special entertainment for everyone Wednesday evening; and the traditional dinner-dance on Thursday evening.

The Women's Activity Committee, under the chairmanship of Mrs. C. E. Drummond, Jr., and Mrs. Robert Stiemke, has been working diligently to provide a pleasant week for the visiting ladies. During Convention week a ladies' headquarters will be maintained at the Atlanta Biltmore. To get the day's activities off to a good start, there will be a coffee hour around nine each morning. On Wednesday, the group will be taken on a tour of some of the beautiful houses in Atlanta, followed by a tea at the home of Mrs. Blake R. Van Leer, wife of the president of Georgia Institute of Technology. After the coffee hour on Thursday, the ladies will take the tour to Stone Mountain and the Cyclorama, followed by a luncheon at the Piedmont Driving Club. In the afternoon there will be a fashion show and tea at Rich's Department Store. Friday the group will be entertained at a 10:00 a.m. brunch at the Franklin Simon Department Store.

Hotel Reservations

A Reservations Committee has been organized for the Convention. Since all requests for rooms will be handled in chronological order, applications should be sent in as soon as possible. A certain number of rooms will be reserved at convenient downtown hotels as well as at the Convention headquarters hotel, the Atlanta Biltmore. Because of the limited number of single rooms available, guests will have a better chance of securing accommodations at the headquarters hotel if their requests for reservations call for rooms to be occupied by two or more persons. When all available rooms at the Atlanta Biltmore are filled, the Reservations Committee will place guests at other hotels.

All reservations should be made to the Reservations Committee, ASCE Convention, the Atlanta Biltmore, Atlanta, Ga. Reservations will be confirmed if requests are received by January 15.

Information and Registration

Members are urged to register in advance of the meeting in order to assure reservations for important events that are necessarily limited as to attendance. During the Convention, mail and messages will be held for members at a special registration desk, that will be opened in the Crystal Lounge, off the headquarters hotel lobby.

A network of highways being built in the Atlanta area will give visiting engineers an opportunity to study the vast construction problems involved in relocating large downtown areas.

Program in January Issue

M. E. Cox is chairman of the general committee in charge of the Convention. The full program of Technical Division sessions, social events, and inspection trips will be published in the January issue.

ASCE Committee on Atomic Energy Reports

The Society's Committee on Atomic Energy, which was formed to study and recommend policies or actions of concern to the members of ASCE, arising from the nuclear energy development, reports its activities to date. Conversations have been held on behalf of the committee with the following officials of the Atomic Energy Commission: M. W. Boyer, general manager [Gen. K. D. Nichols has been named manager to replace Mr. Boyer, who resigned as of November 1]; W. J. Williams, deputy general manager; E. J. Block, director, Division of Construction and Supply; R. W Alger, chief, Engineering Branch, Division of Construction and Supply; U. M. Staebler, Division of Reactor Development; and D. Z. Beckler and G. G. Manov, Office of Industrial Development. Messrs. Boyer and Williams referred to the method of design and construction of AEC installations, instituted by the AEC's predecessor—the Manhattan Engineer District—and subsequently followed by the Commission. The method called for:

1. The careful selection of the best industrial concern that could be found to undertake the design and construction of a facility.
2. The gathering together of a competent AEC group to work with, check, and supervise the contractor.
3. The setting up of a separate AEC headquarters group to make a critical evaluation of the performance.
4. In the infrequent event that the foregoing could not agree after discussion, a visit by the deputy general manager to the site to personally weigh the situation.

Great numbers of civil engineers have been employed by the contractors in the design and construction phases of each AEC operation. By their adherence to high professional standards, these engineers have made a valuable contribution to the resulting facilities. At the same time, the method pursued by the AEC has secured good results with direct employment of an amazingly small staff.

Initially there were some differences of practice between contractors, but these have been eliminated by setting up "Design Criteria," which had been assembled by the Engineering Branch of the Division of Construction and Supply. By following these criteria it should be possible to secure, at minimum cost, the desired degree of security and uniformity of building construction practice.

General Manager Boyer pointed out a vital difference between an ordinary commercial operation and an operation of AEC. The former could carefully weigh costs and proceed only if there appeared reasonable prospect of a profit; the latter, under the urge of military necessity, could be satisfied with nothing less than the certainty of the desired result.

He said that he was pleased to know of the existence of the ASCE committee

and that he could imagine future occasions when he could call on it for specific help as, for example, when a controversial matter might be under discussion before a Congressional committee. The ASCE Committee on Atomic Energy, of course, would expect to transmit such a request to the Board of Direction in order that the Board could appoint those whom it considered best fitted for the particular task.

Reactors for Commercial Power

The discussions with Messrs. Block, Alger, Staebler, Beckler, and Manov all arrived at the same conclusion—the probable construction of reactors to produce commercial power. In this field there are problems, in the solution of which help will be welcome. After a site has been selected in accordance with rules that have been (or will be) established because of the hazardous nature of a reactor, the decision must be made as to the type of structure which will house the unit. No one seems to regard the Schenectady sphere—now in the news—as the final answer. Perhaps a closed, gas-tight structure of a near-conventional type, capable of retaining any contamination which escaped from the unit, will be the solution. The commercial feasibility of producing power might conceivably depend on the cost of such a structure. It was suggested that a trial design, when made, might be submitted to an ASCE committee for criticism.

A somewhat related problem—that is, the shielding of a reactor by space or various materials to reduce ionizing radiation—has been given considerable study, but is not yet regarded as wholly solved. The problem of waste disposal also has been widely studied, but it is realized that much more remains to be done.

Proposed Topics for Committee Activity

The committee recognizes that it is working in a field that has been given much study, research, and thought of an operations-analysis type. Nevertheless, the committee believes it can perform a useful service. One such function would be to serve as a channel for passing information to the ASCE membership.

A number of topics have been suggested which might engage the attention of the committee. Some of these are closely related to the discussions held with AEC personnel:

1. Fees for consultants and payment for engineering services by the AEC. There is prospect of presenting data to the Committee on Professional Practice for appropriate action.
2. Development of cooperation with other engineering societies in this study, with probable Engineers Joint Council sponsorship.
3. The utilization of waste heat.
4. Recommendations and advice leading to the instigation of further studies for the undergraduate civil engineer in the atomic energy field.
5. The planning of atomic energy communities.

The ASCE Committee on Atomic Energy will be pleased to consider other topics of study from engineers who are employed by the AEC, or by its contractors, or by those who have no direct connection with the program. Members of the committee are H. L. Bowman, chairman; R. T. Colburn, Rolf Eliassen, and Josef C. Patchen.

AGC–ASCE Joint Cooperative Committee Meets

Several matters of mutual interest to engineers and contractors were studied at the meeting of the ASCE-AGC Joint Cooperative Committee held in New York in October during the Society's Annual Convention. These covered engineering education, with the committee recommending that the appropriate committees of AGC and ASCE meet jointly to discuss the question of construction courses in the broad field of engineering education. Engineering manpower was also discussed, with the committee endorsing the activity of ASCE, AGC, and other units of the Engineering Manpower Commission of Engineers Joint Council and recommending continued participation of the construction industry in the Commission's work. It was voted that a special task force be set up to review the standard bid procedure document published by the AIA and AGC and recommend whether ASCE should endorse it or prepare a similar document with AGC. A review of the policy regarding the correction of errors in bids is held particularly important.

In a study of engineering salaries and unionization of professional engineers, it was reported that increased efforts to unionize professional employees are evident in California and Ohio, and that such efforts might spread to New Jersey. The committee was notified of the proposed ASCE survey to determine the extent of the salary differential in the preprofessional field, and the cooperation of AGC was asked in the conduct of the survey. It was the consensus of the joint committee that unionization would be much less attractive if more employers would adopt the policy of treating professionals as professionals and would give them the opportunity to develop a proprietary interest in the business by adopting such measures as profit-sharing plans, etc.

ASCE members of the Joint Cooperative Committee attending the meeting were Past-President Gail A. Hathaway, co-chairman; Eugene L. Macdonald, Charles B. Molineaux, Maurice N. Quade, Mason C. Prichard, Kirby Smith, Robert K. Lockwood, and Carl E. Beam, co-secretary. Attending for AGC were Dwight W. Winkelman, co-chairman; A. S. Horner, Walter Couse, Howard Dixon, and Archie N. Carter, co-secretary. Mr. Molineaux will succeed Mr. Hathaway as co-chairman for ASCE.

J. Waldo Smith Hydraulic Fellowship Offered

Availability of another (1954) $1,000 award for a student engaging in one academic year of full-time graduate study in hydraulics is announced by the ASCE Committee for the J. Waldo Smith Hydraulic Fellowship. Applications should be routed through the institution at which the research will be undertaken. The engineering faculty at the institution will cooperate in the administration of the fellowship, and will receive an allowance of up to $400 for equipment.

Applicants should be less than 30 years old and either an Associate or (preferably) Junior Member of ASCE. They cannot accept other appointments or part-time jobs during the academic year. Conditions of administering the fellowship are given in the current ASCE Official Register. It will be noted that the proposed project should be in the field of experimental, as distinguished from purely theoretical, hydraulics, with the purpose of developing a better understanding of fluid flow. A complete comprehensive report of the research undertaken must be sent to the Executive Secretary of ASCE before August 31, 1955.

Applications should be submitted to Karl R. Kennison, Chairman, J. Waldo Smith Hydraulic Fellowship Committee, c/o Board of Water Supply, 120 Wall Street, New York 5, N. Y., before May 1, 1954. They should include three copies of a summary of the applicant's training, experience, and personal data, with a recent photograph and outline of his proposed research project; three copies of a

letter from the department head appraising the applicant's qualifications for the project; one transcript of his academic record; and a letter from the dean or similar officer certifying that the applicant is eligible for full-time graduate study and that the proposed project has administrative approval.

Civil Engineer Wins Alfred Noble Prize

The Alfred Noble Prize goes this year to Henry M. Paynter, Jr., J. M. ASCE, assistant professor of hydraulic engineering at Massachusetts Institute of Technology, for a paper, "Electrical Analogies and Electronic Computers: Surge and Water Hammer Problems," published as Proceedings Separate No. 146 in August 1952.

A graduate of M.I.T. in 1944 with an S.B. degree in civil engineering, Mr. Paynter subsequently received the degrees of S.M. and Sc. D. in hydraulic engineering. He returned to the Institute in 1946 as an assistant in civil engineering after work in Seattle, Wash., with the Puget Sound Power and Light Co. He was promoted to instructor in 1948 and to the rank of assistant professor in 1951. At present he is teaching courses in fluid mechanics, hydrology and water power, and experimental hydromechanics. He is also currently a partner in two consulting ventures in the control and computation field, and is engaged in writing three books on hydraulic engineering subjects.

Henry M. Paynter, Jr.

A joint award of the four Founder Societies and the Western Society of Engineers, the Alfred Noble Prize consists of a cash award of $400 and a certificate. Presentation of the award to Mr. Paynter will probably to be made at the Society's Atlantic City Convention in June.

Our Library Service Grows

RALPH H. PHELPS, Director
Engineering Societies Library, New York

Though this is the fortieth year of the Engineering Societies Library, in a sense the Library is much older for it combines the four libraries of the Founder Societies started in the early days of each society. These libraries, and the offer by Schuyler Skaats Wheeler to give the remarkable Latimer Clark collection of books on electricity to the American Institute of Electrical Engineers, if suitable housing could be made available, were important factors in making it possible for the Founder Societies to have their present building. Now the Engineering Societies Library is an important factor in promoting the interest of outside groups in making a new home available for the engineering profession.

Forty Years of Progress

The relatively unorganized separate collections of forty years ago have been combined, organized and cataloged. Duplication has been eliminated, and much material received years ago as gifts but of little value to engineers has been discarded. Through the direction of the Founder Society members who have served on the Library Board and through the work of many staff members, the Engineering Societies Library has become outstanding in the fields of its Founder Societies—civil, electrical, mechanical, mining and metallurgical engineering—but its 170,000 volumes cover all branches of engineering, primarily on the level of graduate and practicing engineers. Some 1,400 periodicals are currently received from all parts of the world.

Through cooperation with the Engineering Index, important engineering books and articles in periodicals received by the Library are indexed in the daily card service and annual volumes of the Engineering Index. Through this, the world's most extensive published index to engineering literature, engineers have a key to the excellent collection of the Engineering Societies Library.

During its forty-year history the Library has developed services that make it useful to those who cannot visit it in person, as well as to those who can. Its staff prepares reviews of hundreds of important engineering books each year. Such reviews, published in the journals of the Founder Societies and of other organizations, make it easy for engineers to learn about new engineering books of interest to them. These and other books in the Engineering Societies Library may be borrowed by members of the Founder Societies. Each year thousands of engineers and many organizations use the Library's literature-searching and translation services, and its photoprint and microfilm copying services that are available to anyone anywhere without membership restriction. Other thousands use the Library's public reading room.

Visitors to the reading room reached an all-time high during the depression years of the 1930's, but the number of those served outside the Library has continually increased. This is a desirable trend as it widens the usefulness of the Library. However, such service adds greatly to the work of the Library, for a request answered by mail takes much more time than one answered in the reading room, where the inquirer usually does much of the work of finding the information wanted.

Use of Library Increases

Use of library services, for which a charge is made, continued to grow. More photoprint and microfilm orders were filled than in any previous year. More words were translated than in any previous year. Fewer, but longer, literature searches were made, so income was higher as was also income from all other paid services. More books were lent to members than in any previous year.

Promotion

Greater emphasis has been given to publicizing services of the Library. A display box with illuminated transparencies sequentially lighted was developed through efforts of the Library Board. This exhibit was sent to seven of the larger meetings of the Founder Societies. A small peg-board is being developed to be sent to smaller meetings.

More kodachrome transparencies of Library activities were made available through the courtesy of the International Nickel Co. Projection equipment was purchased. Coupon advertisements printed in CIVIL ENGINEERING, have brought many requests for information about the Library, and the services it offers.

Miscellaneous Activities

During the past year the Library staff prepared reviews of 445 books valued at $2,755. These reviews were supplied to the four Founder Societies, the Engineering Institute of Canada, and the Engineering Index. In addition to the value of books received for review, the Library spent about $1,600 for books that were not reviewed.

Engineers, Unionization and Tax Status of ASCE

"Employed engineers seek a way to obtain salaries commensurate with their education and training as compared with that of skilled labor. Some have concluded that the practical and immediate route to salary increases is unionization. Civil engineers look to ASCE for guidance."

This statement is quoted from a 7,000-word memorandum prepared at the request of the Board of Direction by Executive Secretary W. N. Carey and Assistant Secretary E. L. Chandler and subjected to the review and criticism of the ASCE Committee on Employment Conditions, of all members of the Board, and of the Society's legal adviser on labor legislation.

The memorandum provides a better understanding of the Taft-Hartley Act as it may apply to civil engineers; of the part ASCE can properly and legally take in activities covered by the law; of the courses of action open to professionals who wish to avoid aligning themselves with non-professional collective-bargaining organizations; of the procedure of obtaining certification as a collective bargaining unit; of the position of the newly graduated engineer; and of the relation of the tax-exempt status of ASCE to labor relations.

The Society is made up of both employers and employees. Some of the employees are in supervisory positions which, under the Taft-Hartley Act, identify them with employers. No organization made up of a mixture of employers, employees in management position, and other employees can furnish financial support and staff assistance in establishing collective bargaining groups of employees without violating the Taft-Hartley Act. Nor can ASCE or its Local Sections so act for their own members, or groups of members, or act as a collective bargaining agency. ASCE officially can inform its members, and it can urge its non-supervisory employee members to form or not to form a union.

The tax status of the Society as an educational and scientific non-profit organization under Section 101 (6) of the Internal Revenue Code, is entirely apart from its status under the tax law. Even in the event the Society were to give up its tax-exempt status, its scope of activity would still be limited by the Taft-Hartley Act to giving information, advice and direction on collective bargaining to its members.

The memorandum by Secretary Carey and Assistant Secretary Chandler has been distributed to Local Section Officers and to the committees on Conditions of Practice, and Employment Conditions, in the size and format of a Proceedings Separate. As long as the supply lasts one copy will be mailed to any member on request to Executive Secretary W. N. Carey at ASCE Headquarters, 33 West 39th St., New York 18.

(See also "Returns from Questionnaire on Employment Conditions," November "Civil Engineering," page 75.)

Board Confirms 1953–1954 Committee Personnel

The Board of Direction, at its meetings in New York in October, confirmed appointment of ASCE committees for the coming year. The committees of the Board follow. All terms expire October 1954.

Executive Committee: Daniel V. Terrell, Chairman; Edmund Friedman, Vice-Chairman; Walter L. Huber, Carlton S. Proctor, G. Brooks Earnest, Enoch R. Needles, and Mason G. Lockwood.

Honorary Membership: Daniel V. Terrell, Chairman; Edmund Friedman, Vice-Chairman; Walter L. Huber, Carlton S. Proctor, G. Brooks Earnest, Enoch R. Needles, and Mason G. Lockwood.

Districts and Zones: Edmund Friedman, Chairman; G. Brooks Earnest, Enoch R. Needles, and Mason G. Lockwood.

Professional Conduct: James A. Higgs, Chairman; Frank A. Marston, Thomas C. Shedd, and Raymond F. Dawson.

Publications: Frank A. Marston, Chairman; I. C. Steele, Glenn W. Holcomb, Samuel B. Morris, Oliver W. Hartwell, and Ernest W. Carlton.

Membership Qualifications: Walter D. Binger, Chairman; Carl G. Paulsen, Vice-Chairman; George W. McAlpin, M. J. Shelton, Thomas C. Shedd, and William S. LaLonde, Jr.

Division Activities: Edmund Friedman, Chairman; Enoch R. Needles, Vice-Chairman; A. A. K. Booth; Raymond F. Dawson; Frank A. Marston, ex officio (Chmn., Com. on Publications); and Elmer K. Timby, ex officio (Chmn., Com. on Research).

Meetings: Edmund Friedman, Chairman; Enoch R. Needles, Vice-Chairman; G. Brooks Earnest and Mason G. Lockwood.

The Auxiliary Administrative Committees will be:

Annual Convention (Met. Sect.): Wm. S. LaLonde, Jr. (1954), Board Contact Member.

Application Classification: Albert Haertlein, Chairman (1956); Wm. J. Shea (1954); L. G. Holleran (1955); Wm. S. LaLonde, Jr., Contact Member; and Wm. McK. Griffin (1956). Alternates: Harold L. Blakeslee (1954) and Van Tuyl Boughton (1954).

Budget (Terms expire October 1954): Enoch R. Needles, Chairman; Frank A. Marston and S. T. Harding.

Junior Members: Jewell M. Garrelts, Chairman (1956); George H. Lacey, Vice-Chairman (1955); Finley B. Laverty (1954); Robert A. Marr (1957); and Mercel J. Shelton, Contact Member (1954).

Local Sections: Ray L. Derby, Chairman (1954); Charles E. Drummond, Vice-Chairman (1955); Frank C. Mirgain (1956); Eugene F. Bespalow (1957); and C. G. Paulsen, Contact Member (1954).

National Affairs (All terms expire October 1954): Walter D. Binger, Chairman; Samuel B. Morris, J. S. Watkins, Fred J. Lewis and Joseph H. Ehlers, Secretary.

Retirement System: Charles B. Molineaux, Chairman and Contact Member (3 years); John A. Zecca, Secretary (1958); and Wm. J. Shea, Treasurer (1955).

Securities (All terms expire October 1954): E. M. Van Norden, Chairman; George W. Burpee; Walter D. Binger, Contact Member; and John A. Zecca, Secretary.

Student Chapters: George W. Bradshaw, Chairman (1954); Leo C. Novak, Vice-Chairman (1955); Clifford D. Williams, (1956); C. Russell Dole (1957); Charles E. Clarridge (1954); and James A. Higgs, Contact Member (1954).

The new Professional Committees are:

Conditions of Practice Executive Committee (All terms expire October 1954): G. Brooks Earnest, Chairman; Mason G. Lockwood, Vice-Chairman; James A. Higgs, I. C. Steele, M. J. Shelton, C. G. Paulsen, Warren W. Parks, Charles B. Molineaux, Lloyd D. Knapp, and F. M. Dawson.

Registration of Engineers: Harold E. Wessman, Chairman (1956); Alfred Hedefine, Vice-Chairman (1954); Robert E. Stiemke (1955); Wm. F. Spann (1957); and Charles B. Molineaux, Contact Member (1954).

Salaries: Henderson E. McGee, Chairman (1954); Robert J. Ellison, Vice-Chairman (1955); Carroll A. Farwell (1956); Dewitt C. Greer (1957); and Warren W. Parks, Contact Member (1954). Alternate: Don H. Mattern (1957).

Employment Conditions: James I. Ballard, Chairman (1954); Paul M. Went-

worth (1955); Charles M. Yoder (1955); Mauno Backlond (1956); and I. C. Steele, Contact Member (1954). Alternates: Sterling S. Green (1954) and Charles W. Okey (1954).

Engineering Education: Weston S. Evans, Chairman (1957); I. W. Santry, Vice-Chairman (1954); Edwin H. Gaylord (1955); Harry A. Williams (1956); and F. M. Dawson, Contact Member (1954).

Professional Practice: Herbert C. Gee, Chairman (1954); Raymond A. Hill, Vice-Chairman (1956); N. T. Veatch (1955); and Lloyd D. Knapp, Contact Member (1954).

Appointees to the Technical Committees are as follows:

Research: Elmer K. Timby, Chairman (1955); Robert F. Blanks (1956); Francis M. Dawson, Contact Member (1954); Lowell E. Gregg (1957); and Martin A. Mason (1954).

Technical Procedure (All terms expire October 1954): Edmund Friedman,* Chairman; Enoch R. Needles, Vice-Chairman; Frank A. Marston,† A. A. K. Booth, Raymond F. Dawson, and Elmer K. Timby, Chairman, Research Committee. In addition, the committee includes the chairmen of the executive committees of each technical Division.

New appointments to the Joint Committees follow. All terms expire October 1954 unless otherwise noted.

ASCE-AGC Joint Cooperative Committee: Charles B. Molineaux, Chairman and Contact Member; Mason C. Pritchard, Maurice N. Quade, and C. E. Beam, Co-Secretary. Alternate: Kirby Smith.

Engineers Joint Council (Including President, ex-officio without vote): Walter L. Huber, Carlton S. Proctor, G. Brooks Earnest, and W. N. Carey.

ASCE-AIA Joint Cooperative Committee: Craig P. Hazelet, Chairman; Mason G. Lockwood, Contact Member; Wm. O. Hiltabidle; and J. H. Ehlers, Co-Secretary.

Engineering Manpower Commission: Carlton S. Proctor, Contact Member.

Engineers Council for Professional Development: Albert S. Fry (1954); Philip C. Rutledge (1955); Harry S. Rogers (1956); and F. M. Dawson, Contact Member.

John Fritz Medal Board of Award: G. Brooks Earnest (1954); Gail A. Hathaway (1955); Carlton S. Proctor (1956); and Walter L. Huber (1957). Alternates: Albert Haertlein (1954) and William R. Glidden (1955).

Engineering Foundation: Thorndike Saville (1954); Leslie G. Holleran (1955); and Wm. N. Carey (1956).

Washington Award Commission: Howard F. Peckworth (May 1954) and G. Donald Kennedy (May 1955). Alternate: Charles E. DeLeuw (May 1954).

New appointments to the Task Committees follow. All terms expire in October 1954.

Advisory Committee on EJC Water Policy Panel: Louis R. Howson, Chairman; W. L. Chadwick, Vice-Chairman; Norman R. Moore, George W. McAlpin, I. C. Steele, and M. J. Shelton.

George Washington Canal and Locks: U. S. Grant, III, Chairman; A. P. Greensfelder, Co-Chairman; Daniel C. Walser, F. L. Weaver, and C. G. Paulsen, Contact Member.

Administrative Advisory Committee to the Executive Committee: Francis S. Friel, Chairman; Albert Haertlein, George W. Burpee,* and Waldo G. Bowman.*

Defense Design: Carlton S. Proctor, Chairman; George W. Burpee, Wm. N. Carey, Gail A. Hathaway, and Walter L. Huber.

Military Liaison: Carlton S. Proctor, Chairman; Wm. N. Carey, R. E. Dougherty, Gail A. Hathaway, Joseph F. Jelley, Jr., Colby M. Myers, and Lewis A. Pick.

Study of Board Organization: Carlton S. Proctor, Chairman; Wallace L. Chadwick, Louis R. Howson, and Carl G. Paulsen.

Study of Technical Dvision Structure (Advisory to the Executive Committee): Jewell M. Garrelts, Chairman; Frank A. Marston, G. Brooks Earnest, Philip C. Rutledge, Alfred J. Ryan, George R. Schneider, and Edmund Friedman, Contact Member.

* Chairman, Committee on Division Activities
† Chairman, Committee on Publications

* Added for retirement system study.

Daniel W. Mead Prizes Awarded for Essays on Ethics

This year's winners of the 1953 Daniel W. Mead Prizes for the best papers on some phase of professional ethics are Charles W. Griffin, Jr., J. M. ASCE, Erlton, N. J., recipient of the Junior Member prize consisting of $50 in cash and a certificate, and Carl A. Rambow, J. M. ASCE, Muskegon, Mich., who receives the student prize of $25 in cash and a certificate for an essay prepared while he was a student at the California Institute of Technology. Both wrote on the subject, "Under What Circumstances, and to What Extent, Should Duration of Service Constitute a Professional Obligation?"

Charles W. Griffin, Jr.

Carl A. Rambow

Following three years in the Naval Air Corps, Mr. Griffin graduated from George Washington University in June 1949, with a B.C.E. degree. Three years of detailing and design work, under three employers, were followed by a year of structural design with Dorfman & Bloom, Philadelphia consultants. In June of this year he assumed his present duties as field inspector on a large Philadelphia Housing Authority project, under the employment of Oscar S. Stonorov, Architect. He is president of the Philadelphia Section's Junior Forum.

Mr. Rambow entered the California Institute of Technology in 1949 and graduated with honors in 1953. He was a member of the ASCE Student Chapter for three years and has now become a Junior Member. While in school Mr. Rambow spent two summers in various engineering jobs. Upon graduating he joined the U. S. Naval Reserve, was appointed to Officers' Candidate School, and expects to receive a commission in the Civil Engineering Corps in January.

Past-President Huber Honored by Construction Industry

ASCE Past-President Walter L. Huber receives the 1953 Honor Award of the Building Industry Conference Board from Albert S. Evers, Architect, at its Annual Achievement Award Dinner held in San Francisco on November 12, with some 400 leaders in the field in attendance. Mr. Huber was honored on the basis of his work in the industry, which has included the structural design for the Union Square Garage and for work now in progress at the University of California Medical Center. Recipient of the organization's other award for the year was Robert Gordon Sproul, president of the University of California, who received the 1953 Achievement Award for research in the field of building materials he has furthered as university president.

ASCE Instrumental in Establishing Standard Time

The seventieth anniversary of the establishment of the standard time system in the United States, observed on November 18, recalls the major role played by civil engineers, particularly ASCE, in bringing the reform. Where method and system now prevail there was, prior to November 18, 1883, only confusion. Throughout the country different communities kept their own local time, and each railroad had its own time. In 1870 Charles F. Dowd, of Saratoga Springs, N. Y., head of a girls' school and a leader in the campaign for standardization, published a 107-page book, *A System of National Time for Railroads*, which showed variations for 8,000 depots on some 500 railroads.

By 1870 the problem had engrossed the attention of ASCE, the American Meteorological Society, and the American Society for the Advancement of Science. Sir Sandford Fleming, M. ASCE, chief engineer of the Canadian Government, urged adoption of a uniform world time system at a meeting of the Canadian Institution in Toronto and at the Annual Convention of the ASCE in Montreal in 1881. He headed a special committee of ASCE to study the question. On January 17, 1882, the committee stated, "Standard time for general use throughout the country is urgently demanded . . .The time has arrived when action should be taken . . . Mistakes in the hour of the day are frequent . . . In every state, in every city and town discrepancies are met which produce great aggregate inconveniences."

At its Annual Meeting in New York in 1882, ASCE resolved to invite other societies, the states, federal departments, and other interests to cooperate with it "in an effort to effect a satisfactory and speedy settlement of the important public question." In particular, the special committee sought the cooperation of railway and telegraph systems, and the Society called for an international congress to be held in Washington "for the purpose of determining the time system which it would be advisable to adopt."

The congress was held in 1884, with 25 nations represented. It advocated a universal day, which would not interfere with local or other standard time. Meanwhile, on November 18, 1883, the American and Canadian standardization system had gone into effect, and there had been established in the United States and Canada five time zones—Atlantic, Eastern, Central, Mountain, and Pacific—four, five, six, seven, and eight hours slower than Greenwich Time.

The February 1896 PROCEEDINGS said in part: "Thus it will be seen that the reform of time-reckoning, to a large extent initiated by the American Society of Civil Engineers and which for the past 15 years this Society has done so much to promote, continues to make substantial progress throughout the world. We have every reason to believe that before long unification of time will practically be complete."

ASCE Centennial Volume of Transactions Issued

The outstanding engineering thought of today, and the engineering progress of the past century are discussed in the 1,330-page Centennial Transactions of ASCE, which can now be ordered. Designated Volume CT, as distinguished from the regular 1953 volume, the book contains papers presented at the Centennial Convention of ASCE in Chicago, Ill., in September 1952.

The first section of the volume sets the overall theme—the history, philosophy and progress of civil engineering. This section includes the annual address of the president of ASCE among similarly notable papers. In subsequent sections prominent authors from all technical branches of civil engineering have contributed papers on such diversified subjects as engineering education, city planning, construction, irrigation, and power. Modern advances in sanitary engineering and surveying are described, and the use of timber in engineering is a featured structural topic. Soil mechanics, transportation, waterways, and allied interests are also included in the eighty-one papers.

Those who have not previously ordered Volume CT can now do so by use of the coupon on page 121.

James L. Head Elected President of UET

In its annual election of officers, United Engineering Trustees, Inc., has named as president, James L. Head, a mining engineer with the Anaconda Copper Mining Co. Mr. Head, who has been chairman of the Engineering Societies Library for the past two years and vice-president of UET, succeeds R.F. Gagg, president for the past two years.

Other officers elected were Gail F. Moulton of Rockefeller Brothers, Inc., and Walter J. Barrett of New Jersey Bell Telephone Co., vice presidents; Waldo G. Bowman, M. ASCE, of McGraw-Hill Publishing Co., treasurer; and Joseph L. Kopf of Jabez Burns & Sons, Inc., assistant treasurer. John H. R. Arms was reelected secretary and general manager, a position he has occupied since 1933. Mr. Moulton was elected chairman of the finance committee, and Mr. Gagg chairman of the real estate committee.

FROM THE NATION'S CAPITAL

JOSEPH H. EHLERS, M. ASCE — Field Representative ASCE

Competitive Bidding for Professional Services Again Rears Its Ugly Head

Recently the Chief Highway Commissioner of the State Highway Department of South Carolina advertised in several engineering publications for sealed competitive bids from engineering firms for making plans and specifications, and checking shop drawings for a movable highway bridge. The "Notice to Bridge Engineers" included the following requirement:

"Bids must be submitted on official proposal forms, copies of which may be obtained at the address shown below (Chief Highway Commissioner). Bids must be based on a percentage of the contract costs of the portions of the bridge stated above. Lump sum bids will not be accepted. The Department reserves the right to reject any or all bids, waive technicalities, and to make such awards as it deems to be to its best interests."

Thirteen engineering firms answered the advertisement with offers to prepare the plans and specifications. When the bids were opened, each bidder received from the state highway department a list of the bidders and the fee for which each offered to make the designs. The bids ranged from 2.9 to 7.5 percent.

In view of this effort to secure competitive sealed bids on a price basis for professional engineering services, the following two letters sent by the Field Representative in connection with another case may serve to remind our membership that this practice is a direct violation of the Code of Ethics of the Society.

Competitive bidding for professional engineering services has been discussed for years. It has long been the general conclusion that competitive bidding for professional services is not compatible with professional status. This view has been established definitely by the Society's Code. It is the fundamental basis for any past and present considerations of the question of whether we as engineers wish to continue engineering as a profession like the law or medicine or to develop it into a business such as construction contracting or manufacturing.

American Society of Civil Engineers

"Washington, D.C.
September 23, 1953

"Mr. Charles E. Slusser
Commissioner
Public Housing Administration
1201 Connecticut Avenue, N.W.
Washington, D.C.

"Dear Mr. Slusser:

"It has been reported to me that competitive bids will be sought for engineering services in connection with a housing project in the Linda Vista area in San Diego, Calif. At first I thought there might be some question as to whether you considered professional services to be involved. In a brief telephone conversation with the Director of the San Francisco office I learned that this work does involve professional engineering services; and that it is the opinion of the agency that competitive bidding is required by law.

"On behalf of the American Society of Civil Engineers, I would like to protest against obtaining such services through competitive bidding on a price basis, and to suggest a procedure which I believe will secure better results for you. The services of such professional people as civil engineers, architects and lawyers have not customarily been obtained by government through competitive bidding.

"It is contrary to the ethical practice of these professions to engage in competitive bidding. Article 4 of the Code of Ethics of the American Society of Civil Engineers reads as follows:

'It shall be considered unprofessional and inconsistent with honorable and dignified bearing for any member of the American Society of Civil Engineers to participate in competitive bidding on a price basis to secure a professional engagement.'

Also I refer to the following policy statement of the Chamber of Commerce of the United States:

'Competitive bidding for construction contracts is the accepted method of securing economy and efficiency in public construction. This policy does not apply to professional design services, which should never be obtained through competitive bidding.'

"It is my opinion that competitive bids for engineering services make little sense. The bids received do not relate to the same thing, for no language can describe exactly how much professional skill or thinking should be devoted to performing the work. A low bid might well represent someone's view of a minimum amount of service that could produce a minimum possible result.

"Money is expended for professional engineering services to a considerable extent in order to save money on the total cost of a project as constructed. Sometimes such lowest total cost is brought about by spending a maximum rather than a minimum amount on engineering analysis and design.

"My concern in raising these points with you does not relate to whether a professional society member gets an engagement; but rather whether you as an owner will get a project which will be a credit to the engineering profession and represent a sound investment of public funds. Actually, with members of the great professional engineering societies refusing to participate in competitive bidding, an opportunity is afforded to someone not bound by any code of ethics, and knowing that others will not bid, to put in a bid at a higher figure than a negotiated contract would have involved or than the job is worth.

"The American Society of Civil Engineers has prepared some curves showing what fees have been paid in the past for engineering services for jobs of various magnitudes. A copy is enclosed. We also have a Manual dealing with this subject in greater detail. Several government agencies also have manuals setting forth their methods of awarding contracts for professional services which are in accordance with the codes of ethics of the professional societies.

"A few agencies have felt that they were required by statute to call for competitive bids. Under the 'Federal Property and Administrative Services Act of 1949'—P.L. 152, 81st Congress—provision is made for the granting of exemptions to other agencies by the General Services Administrator. In a situation that arose recently, the Administrator of the Housing and Home Finance Agency, at the suggestion of this office, requested such an exemption. It would appear that this exemption was granted in sufficiently broad terms to cover

ASCE MEMBERSHIP AS OF NOVEMBER 9, 1953

Members	8,476
Associate Members	10,774
Junior Members	17,281
Affiliates	69
Honorary Members	43
Total	36,643
November 10, 1952	35,463

the prospective San Diego work. A copy is enclosed herewith (from *Federal Register*, Friday, July 10, 1953).

"I will greatly appreciate your considertaion of these thoughts and will be glad to confer with any members of your staff in working out a procedure satisfactory to all parties and in the best interests of the public and the government.

"Sincerely yours,

"Joseph H. Ehlers
"*Field Representative*"

American Society of Civil Engineers

"Washington, D. C.
November 9, 1953

"Mr. Charles E. Slusser
Commissioner
Public Housing Administration
1201 Connecticut Avenue, N.W.
Washington, D.C.

"Dear Mr. Slusser:

"This acknowledges your letter of October 30, 1953, expressing the views of the Public Housing Administration on competitive bidding for professional engineering services in general and also in particular reference to the Linda Vista housing project in San Diego.

"You state that you recognize that it might be legally permissible to negotiate this contract under the July 7, 1953, authorization at the option of the Housing and Home Finance Agency. It is my understanding that this delegation was extended in very broad terms, broader than the request for it. However, as a policy, you approve of competitive bidding for engineering services.

"With no legal question involved any longer, I would like to comment on the policy question involved. I am greatly disturbed by the letter of January 1951 to Senator Knowland which you enclosed as expressive of your policy. I believe the policy of that time should be reviewed. In my opinion that letter would force Senator Knowland to some false conclusions as to certain facts.

"The statement is made that 'the statutory requirement of advertising is expressive of a long established policy of the Congress.' Bearing in mind that the subject of the letter to Senator Knowland is 'advertising for *professional engineering services*,' the policy stated is in my opinion quite contradictory to the policy of the Congress. I would hazard an opinion that from 99 to 99.99 percent of all federal construction under Congressional appropriations during the past two decades has been done in connection with professional engineering and architectural services for which there was no advertising and no competitive bidding. Not only is that the case for all federal construction, but I am convinced that even on projects with which the Public Housing Administration and its predecessor agencies have ever been connected, regardless of who let the contracts, 99 percent of the engineering and architectural services have been under negotiated contracts for which there was no advertising. If I recall correctly, there was no advertising whatever for the engineering and architectural services in connection with the original design work on this federally built Linda Vista project itself.

"In connection with the reference in the letter to 'requiring advertising for bids where sound business practice indicates its desirability,' I would again refer you to the policy statement of the Chamber of Commerce of the United States: '*This policy does not apply to professional design services, which should never be obtained through competitive bidding.*'

"The prohibition against entering into competitive bidding in the Codes of Ethics of the American Society of Civil Engineers, the American Institute of Architects, the National Society of Professional Engineers, and practically all the other professional engineering societies was not made for the selfish advantage of their members but rather for the protection of the public. The public deserves this same protection to its safety and welfare on your projects through the best engineering and architectural services, as provided on other federal and private projects.

"We as engineers are firm believers in competitive bidding for procuring commodities and in construction operations. In these cases specifications require the same end product from all competitors. We of the professions are not merchandising a commodity which is tangible or easily measurable. No one has devised a specification to describe a required standard of skill or of thinking; hence on professional work, lawyers, doctors, architects and engineers do not bid on a price basis.

. . . .

"I have submitted this letter to representatives of the American Institute of Architects, the National Society of Professional Engineers, and the Chamber of Commerce of the United States. Several of them stated that they condemn the practice you propose in stronger terms than I have.

. . . .

"Frankly, the professional societies consider it their duty to eliminate such an unethical practice that is fraught with such danger to the health and safety of the public.

"I hope that you may decide to use the delegation of authority referred to previously, which would permit whatever professional engineering and architectural work as is here involved to be done under negotiated contracts without advertising. In that event I would be glad to render any assistance possible.

"Sincerely yours,

"Joseph H. Ehlers
"*Field Representative*"

Hawaii Section to Have All-Day Convention, March 1

The Hawaii Section of ASCE has scheduled its 1954 Convention for March 1 at the Queen's Surf, a beautiful and popular eating place on the beach at Waikiki. The program will consist of breakfast; a morning technical session; a luncheon, to which the University of Hawaii Student Chapter will be host; an afternoon technical session; and dinner and dancing in the evening. A complete program of interesting events is planned for the ladies. Descriptive information is being sent to all Local Sections.

Make plans now to attend and send reservation to: Donald S. Austin, Convention Chairman, c/o Austin and Towill, Civil Engineers, 205 Merchant Street, Honolulu, Hawaii.

Fenn College C.E. Program Accredited by ECPD

Final accreditation of the Fenn College program in civil engineering by the Engineers Council for Professional Development is announced by Dr. William A. Patterson, dean of the Fenn School of Engineering. The civil engineering program is the fourth of five major engineering curricula at the college to be approved by ECPD.

James Byrnside Akers Posthumously Honored

The late James Byrnside Akers, M. ASCE, chief engineer of the Southern Railway System, who died on July 8, 1953, was posthumously honored by his friends in the office of the chief engineer with a commemorative scroll. The scroll pays tribute "to his intelligence, to his sympathetic understanding, to his modesty, to his inherent good humor, and his never failing patience. He exercised authority easily," it continues, "and often helped carry the burdens of lesser men. He was both our mentor and our friend . . . and the example of his character will live on." Professionally the scroll cites "the respect for his ability throughout the railroad industry."

Coming Events

Duluth—Luncheon meetings the third Monday of the month at the Kitchi Gammi Club, 831 E. Superior St., 12 noon.

Georgia—All-day annual meeting featuring technical sessions, luncheon, dinner, and dance, at the Dinkler-Plaza Hotel Roof, Atlanta, Ga., starting at 10 a.m., December 5.

Intermountain—Annual meeting and canvass of ballots for election of officers, December 17.

Hawaii—All-day meeting program consisting of breakfast, technical sessions, luncheon and dinner-dance, at the Queen's Surf, Honolulu, on March 1. For reservations write to Mr. Donald S. Austin, Convention Chairman, Austin and Towill, Civil Engineers, 205 Merchant St., Honolulu, Hawaii.

Kansas—Meeting in Topeka on January 15.

Maine—Annual Highway Conference at the University of Maine, in cooperation with the ASCE Student Chapter and the Maine State Highway Commission, December 18–19.

Metropolitan—Meeting in the auditorium of the Engineering Societies Building, 33 West 39th St., New York, N.Y., on December 16, 7 p.m. The Junior Branch meets in the ASCE Board Room at the same address, January 13, 7:30 p.m.

Mid-South—Annual meeting at the Hotel Heidelberg, Jackson, Miss., December 10–12. Tentative program includes an Early Bird Party on the evening of the 10th, business and technical sessions, a luncheon, social hour, and banquet, and a field trip to the Marquette Cement plant, Brandon, Miss.

Philadelphia—Dinner meeting at the Engineers Club, December 8. Joint dinner meeting of the Central Pennsylvania Subsection with the Engineers Society of Pennsylvania and the Harrisburg chapter of the Pennsylvania Society of Professional Engineers at the Civic Club, Harrisburg, Pa., January 13, 6:30 p.m.

Providence—Meeting at the Providence Engineering Society on December 10, preceded by dinner at the Crown Hotel.

South Carolina—Annual meeting of the Columbia Hotel, Columbia, S.C., January 22.

Sacramento—Weekly luncheon meetings at the Elks Temple every Tuesday at 12 noon.

Tacoma—Meeting at the Allenmore Golf Club House on December 11. Dinner-dance at the Steak House on January 15.

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the tenth of the month preceding date of publication.)

Holding its annual fall meeting during the fifth annual joint meeting of Arizona's engineering societies, which took place in Phoenix, November 6 and 7, the **Arizona Section** devoted a full day to technical sessions. There were papers by A. V. K. Babcock, industrial development manager of the Arizona Public Service Co., who discussed the state's industrial development and potential; John A. Carollo, Phoenix consultant, whose subject was "Sanitary Districts in Arizona"; W. T. Hamlyn, another Phoenix consultant, who explained lift-slab construction; and Karl Harris, project supervisor of Irrigation Research for the U.S. Soil Conservation Service, who described a method of computing irrigation water use. A joint luncheon with the American Association of Engineers was addressed by W. E. Willey, engineer of economics for the Arizona Highway Department. The social program began with a dinner, with the Arizona Society of Professional Engineers as host, and ended with a chuck wagon dinner and dance.

"The Hardest Working River in New York State" is what Fred W. Reusswig and David S. Summerville, of the Niagara Mohawk Power Corp., termed the Raquette River in talks describing the development of that stream that featured the program for the

Maj. Gen. Samuel D. Sturgis, Jr., Chief of Engineers, U.S. Army, attends a joint luncheon meeting of the Vicksburg Branch of the Mid-South Section, the local section of the Society of American Military Engineers, and the Vicksburg Engineers Club. In left background is Col. C. H. Dunn, director of the U.S. Waterways Experiment Station, at right Donald Coe, president of the Engineers Club. In a talk on current Corps of Engineers problems and aims, General Sturgis stressed the fact that the Corps is attempting to carry out wartime operations while subject to peacetime limitations.

Attending meeting of District 6 Council, held at Clarksburg, W. Va., during the recent annual meeting of the West Virginia Section, are (seated, in usual order): George S. Richardson, Pittsburgh Section (past-president), and George W. McAlpin, ASCE Director for District 6. Standing are Kenath A. Kettle, president of West Virginia Section and Council secretary; Perley Rice, Virginia Section (past-president); W. S. Spencer, Maryland Section (president); and Fred Palmer, West Virginia Section (president-elect). ASCE President Daniel V. Terrell was principal speaker at the banquet concluding the program.

Buffalo Section's October meeting. With completion of a $25,000,000 project now being built by the Niagara Mohawk Power Corp., over 1,200 ft of head will be developed on the stream, they said. The present project consists of five developments. Juniors arranged and presented the meeting—an innovation in Buffalo Section operation.

Inspection of Cincinnati's Little Miami Sewage Treatment Plant was the principal feature of the **Cincinnati Section's** October meeting. Host for the occasion was Art Caster, sewage disposal engineer for the city. Later in the season the Section is planning to sponsor a "Sanitary Science Workshop," to which sanitary engineers and allied scientists will be invited.

The fine points of stadium design were brought out in the leading talk at the October 16 meeting of the **Cleveland Section,** given by Homer T. Borton, vice-president of the Osborn Engineering Co. Mr. Borton said that stadium costs today are averaging $100 to $150 a seat. This cost, along with parking problems, is expected to limit the size of stadiums to a seating capacity of about 50,000. Stadiums of the future, according to Mr. Borton, may have escalators, more effective color schemes, and improved lighting. Studies of orange-peel design for stadiums currently under way would permit enclosing them during bad weather.

Conservation in relation to engineering was discussed at the October 28 meeting of the **Connecticut Section** by Prof. Paul B. Sears, of the Yale University Conservation Department. Reports on the recent Local Section Conference in New York and on the New England Council in Boston were given by Secretary Earl R. Howard.

Senator Ralph Flanders of Vermont was guest of honor and speaker at a joint meeting of the **Delaware Section** and the Delaware Engineering Association held in Wilmington on November 2. There was a turnout of 400 to hear the Senator, whose subject was "The Application of Engineering Principles in Government." At the October meeting Walter C. Voss, retired head of the Department of Building Engineering and Construction at M.I.T., spoke on "Remedies for Common Difficulties in Building Construction."

ASCE Director Mercel J. Shelton visited the **Intermountain Section** on October 27 and reported the events of Annual Convention week at a special meeting. The speaker of the evening at the Section's regular October meeting was George M. Gadsby, president and chairman of the board of the Utah Power & Light Co., who discussed "Energy Trends."

Details of a study now under way in Iowa to determine the feasibility of a toll road for the state were discussed at a recent joint meeting of the **Iowa Section** and the Iowa State College Student Chapter, with E. F. Koch, chief engineer of the Iowa Highway Commission, the featured speaker. The turnout of 165 included many students.

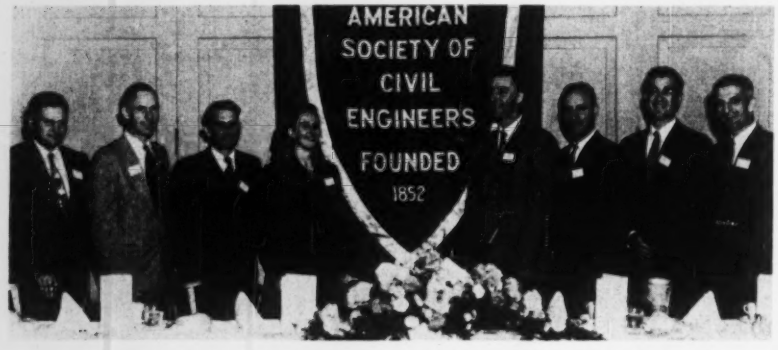
What Cornell University civil engineering students learn at Camp Cornell, the Civil Engineering School's Summer Survey Camp, was demonstrated at an outing early in the fall for members of the **Ithaca Section** and their families. The school staff were hosts for the event, which featured competitions in surveying tests. A chicken dinner was followed by a talk on "Surveying, Photogrammetry, and Forestry," given by Prof. Bruce Stanton, of the Syracuse University College of Forestry. The erection of the second Tacoma Narrows Bridge was discussed for the benefit of members attending the October meeting by Jackson Durkee, of the Bethlehem Steel Co.

The replacement program for locks and dams on the Ohio River was described at the October 30 meeting of the **Kentucky Section** by Col. W. D. Milne, district engineer for the Louisville District of the Corps of Engineers. Quarterly publication of the Section's News Letter, initiated in June on a tentative basis, was decided upon, on the basis of favorable response to the first number. Wm. B. Drake will be editor, in line with a decision to make the corresponding secretary editor.

The **Los Angeles Section** was one of the cooperating groups for the Western Conference on Prestressed Concrete held in Los Angeles, November 14 and 15.

Officers for the recently formed (July) **Shreveport Subsection** of the **Louisiana Section,** elected at its November meeting, are W. C. Sorensen, president; Francis W. Grant, first vice-president; T. F. Quinn, second vice-president; Val A. Lyons, secretary; and R. E. Gregory, treasurer.

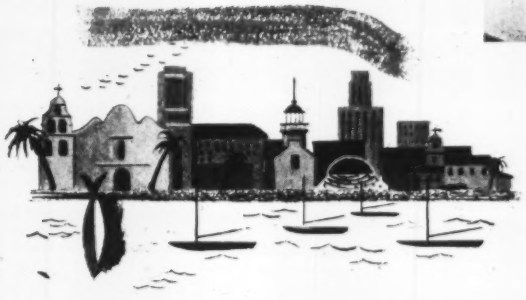
Members of the **Maine Section** and its recently organized **New Hampshire Branch,** at the first joint meeting of the two groups which was held in Portsmouth on October 9, heard ASCE Director Frank Marston



Montana Section officers, photographed at the banquet closing the Section's annual meeting held in Helena, September 18 and 19, are (left to right) Harold L. Eagle, Helena, vice-president; O. C. Reedy, Billings, vice-president; Donald R. Cubbage, Great Falls, vice-president; Lucy W. Pettapiece, Cascade, secretary-treasurer; George J. Hoge, Great Falls, president; J. A. Maierle, Helena, retiring president; Donald H. Park, Helena, retiring secretary-treasurer; and Frank Stermitz, Helena, retiring vice-president. R. R. Renne, president of Montana State College and former MSA administrator in the Philippines, gave the major address of the meeting on "Our Foreign Aid Program."

Group of members and officers of the Sacramento Section and its Central Valley Subsection attending a recent joint meeting held at the Calaveras Cement Company's plant (November issue, page 78) are R. Robinson Rowe; Harry Cedergren; Frank Davis; Walter Schultz, president of Sacramento Section; Edward Tenney; John Myers, president, Central Valley Subsection; Harry Moses; Frank Lucas; and Felix Wallace.

San Diego Prefers **Concrete** Pressure Pipe



Fast growing San Diego uses over 45,000,000 gallons of water each day, most of it supplied from reservoirs strategically located in the Incopah Mountain Range in back of the city. Concrete pressure pipe delivers nearly all this water to San Diego.

And San Diego continues to specify concrete pressure pipe. One of the latest installations in this area was the Sweetwater extension to the San Diego aqueduct. Here over 23,000 feet of 18-inch and 24-inch pipe was used to improve the water supply system.

Concrete pressure pipe provides maximum hydraulic capacity for extremely long periods of time. This, plus other outstanding advantages, such as immunity to rupture or blowout and the little or no maintenance required, make it important for every city to investigate its use for water conduit systems.

Water for Generations to come

Concrete PRESSURE Pipe

AMERICAN CONCRETE PRESSURE PIPE ASSOCIATION
228 North LaSalle Street
Chicago 1, Illinois

speak briefly on the benefits of Society membership, and Assistant Secretary E. Lawrence Chandler discuss the problem of collective bargaining for engineers. A good turnout of Maine Section members in the Portland area heard Charles F. Parker discuss his engineering experiences on the construction of Thule Airbase in Greenland at a supper meeting on October 26. On the same date Augusta area members met for luncheon and heard Ivan Jenkins describe his experiences as a highway engineer trainee in the Bureau of Public Roads, and Miner Stackpole discuss the work of the U.S. Geological Survey in Maine.

As an aid to its members required to take the examination for Professional Engineer, the **Miami Section** has appointed a committee to organize a refresher course. The principal speaker at the Section's October meeting was Richard B. Roberts, vice-president and director of economic research for the Florida Power & Light Co. In a talk on "The Development of South Florida," Mr. Roberts forecast a period of remarkable growth for the area.

The intangibles by which engineers are measured, in addition to their technical ability, was the substance of a talk delivered by Francis M. Dawson, Director of the Society and dean of the College of Engineering at the State University of Iowa, at the October meeting of the **Nebraska Section.** Members of the Student Chapter at the University of Nebraska were guests of the Section.

The all-day annual meeting of the **North Carolina Section,** held in Wilmington, N.C., on September 25, featured talks by Ronald H. Ruddell, general superintendent for Ebasco Services, Inc., who discussed his experiences on construction of a major power plant in Chile; C. E. Hartford, vice-president of the Riegel Carolina Corp., who described the manufacture of wood pulp at the Riegel Carolina plant, and Col. Raymond L. Hill, district engineer for the Wilmington District of the Corps of Engineers, whose talk on construction of the Wilmington Ammunition Loading Terminal constituted the luncheon meeting program. A tour of the state's Port Authority terminal, under the direction of George W. Gillette, executive director, concluded the program.

Scheduled ASCE Conventions

ATLANTA CONVENTION
Atlanta, Ga.
Hotel Biltmore
February 15–19, 1954

ATLANTIC CITY CONVENTION
Atlantic City, N.J.
Chalfonte-Haddon Hall
June 14–19, 1954

NEW YORK CONVENTION
Hotel Statler
October 18–22
1954

The history of channel improvement at the mouth of the Columbia River was outlined by Col. Thomas H. Lipscomb, Portland district engineer for the Corps of Engineers, at the **Oregon Section** September dinner meeting. Colonel Lipscomb traced the development of the harbor from the time of its discovery in 1792 to the present, and discussed works that have been proposed to increase the safety of the harbor entrance.

A symposium on the San Marcus Bridge over the Lempa River in El Salvador, Central America, was presented by a panel of engineers who have been working on the project, at the **Philadelphia Section's** first meeting of the season, on October 13. Blair Birdsall, chief engineer for the Bridge Division of John A. Roebling's Sons Corp., presided and also pinchhit for H. K. Preston, Jr., engineer for the same company, who was indisposed and unable to attend the meeting. The other speakers were H. W. Hills and John E. Nixon, also of the John A. Roebling's Sons Corp., and Byron Prugh, of the More-Trench Corp., New York. Construction views of the project, which is of the modern cable stiffening suspension type, added greatly to the program.

Construction of a lift-slab building by the Youtz-Slick Lift Slab Method was described at the **Providence Section's** first meeting of the season, held in Providence on October 8. Robert E. Egelhoff, vice-president of the New England Lift Slab Corp., and featured speaker, showed a color film on the procedure.

Traffic planning by state, county, and municipality was studied at the September meeting of the **San Diego Section** by a panel representing the California State Highway Department, the San Diego County Road Department, and the City of San Diego. The program covered many of the problems confronting the various agencies and proposed solutions.

Surveying in the Arctic was the theme of the annual joint meeting of the **Seattle** and **Tacoma Sections** held at a favorite restaurant midway between the two cities on October 13. The program was moderated by Comdr. Glenn W. Moore, and introduced by a colored movie, "Work of the U.S. Coast and Geodetic Survey." Three engineers from the Survey, with recent experience on survey work in Alaska, then described and showed slides on different phases of the topic. They were Capt. Charles Pierce and Comdrs. Curtis LeFever and Morris A. Hecht. There was a turnout of about 125.

Progress being made by the Governor of Texas's Committee on Water Conservation and the recently established Water Resources Committee was outlined at the October 12 luncheon meeting of the **Texas Section's Fort Worth Branch**. Beeman Fisher, vice-president of the Texas Electric Service Co., substituted for scheduled speaker J. B. Thomas, who was unable to attend. New Branch officers are H. H. Hester, president; J. B. Mapes, vice-president, and A. Blan Bell, secretary-treasurer.

Recent trends in reinforced concrete construction were described at the **Toledo Section's** November dinner meeting by Clayton C. Singleton, regional structural engineer for the Portland Cement Association. Mr. Singleton touched on such features as barrel roofs, precast wall construction, and thin-shell construction.

ASCE Student Chapter at VMI Honored

As feature of Seventh Annual Highway Conference at Virginia Military Institute, ASCE Student Chapter is honored by H. A. De Butts, president of the Southern Railway System. On behalf of VMI alumni who have served the System two or more years, Mr. DeButts presented the Chapter with an old steam locomotive bell engraved with the names of 28 such graduates. Headed by Mr. DeButts, one of the first alumni hired by the Southern Railway, the list includes two members of the class of 1953, latest recruits to the ranks of the System. Shown, left to right, are Cadet E. R. Bare, president of the VMI Chapter, who accepted the bell for the Chapter; Mr. DeButts, who paid a tribute to VMI for its educational leadership in the featured address at the Conference; and R. A. Marr, Faculty Adviser for the Chapter. Cadet Bare announced that the bell will be mounted on an iron stand and used as a gavel.

Piles for railway underpass.

Piles for super-highway bridge.

Piles for sewerage treatment plant.

Piles for railway bridge.

Here's the "straight story" on pipe piles

Straight foundation pipe supports maximum loads. This is why so many engineers like Armco Spiral Welded Pipe Piles — they have exceptional straightness and roundness.

Because of the tough spiral weld of Armco Pipe Piles you get high collapse resistance and extra lateral stiffness even in the longest lengths. And because Armco Piles drive straight, driving time is saved and jobs are completed on schedule.

Diameters range from 6 to 36 inches and wall thicknesses are from $^{9}/_{64}$- to $^{1}/_{2}$-inch. Piles can be supplied in any length that can be handled and shipped.

End plates, points and cutting shoes can be mill-attached, thereby eliminating inconvenience and field welding. And with the uniform diameter of Armco Piles—end to end—it is easier to salvage cut-offs for extending short piles or making new whole piles. Waste is avoided.

Specify Armco Pipe Piles for that next foundation job. Write for more data. Armco Drainage & Metal Products, Inc., 2693 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. In Canada: write Guelph, Ontario. Export: The Armco International Corporation.

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NEWS BRIEFS . . .

Expenditures for Construction at Record October High

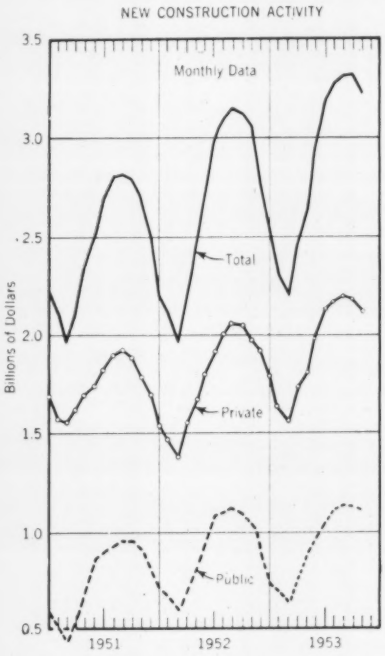
Expenditures of $3.2 billion for new construction during October 1953 almost maintained the September level and set a record for the month, according to preliminary estimates of the Building Materials and Construction Division of the U.S. Department of Commerce and the U.S. Labor Department's Bureau of Labor Statistics. Both private and public outlays—at $2.1 billion and $1.1 billion, respectively—were at peak for the month.

Commercial, educational, and religious building rose contra-seasonally in October to a new monthly high. The decrease from September in highway work was less than seasonal, reflecting to some extent the unusually good construction weather. All other major categories showed the changes that are usual for the time of year.

During the first ten months of 1953 expenditures for all types of new construction totaled $29.1 billion, 7 percent above the amount for the same 1952 period. Physical volume (expenditures adjusted for price changes) was up slightly, 3 percent, from last year.

Almost two-fifths of the total dollar gain over 1952, when the first ten months are compared, was in private residential building. Commercial building accounted for the next greatest share, about one-fourth, largely as a result of advances in construction of stores, restaurants, and garages. Most of the balance of the 1953 rise in construction expenditures was in privately owned public utilities and highway construction.

January-October expenditures for public industrial building (including atomic energy facilities) and for school construction were also considerably greater this year than last, while outlays for hospital construction and public housing were down substantially. Private spending for industrial plant expansion, despite a dip during the summer months, nearly equalled the record 1952 figure for the same ten-month period. Construction of military and naval facilities likewise was only slightly under last year's total for the first ten months, and farm construction was down moderately.



New construction expenditures in October—at $3.2 billion—set a record for the month, as indicated in Department of Commerce Curves.

Role of ASCE in Standardization Hailed at ASA Meeting

ASCE is greatly interested in the establishment of standards, Charles W. Bryan, Jr., M. ASCE, president of the Pullman-Standard Car Manufacturing Co., Chicago, said at the Founders' Day program of the American Standards Association, held October 19 at the Waldorf-Astoria in New York as a feature of the Fourth National Standardization Conference.

In an address commemorating the founding of ASA thirty-five years ago by five engineering societies including ASCE, Mr. Bryan emphasized that the breadth of civil engineers' interests naturally entails a wide interest in the use of standard materials and products. "Without standards and standard specifications to guide the selection of construction materials", he said, "the speed and facility with which large installations are now made would never be realized."

ASCE, Mr. Bryan concluded, "both as a Society and as representing a large group of technical men interested in private and public improvement, has reason to be interested in and to support the development of standards in the civil engineering field which the American Standards Association has done so much to promote."

The five founding societies of ASA were also honored in an address by Roger E. Gay, president of ASA and of the Bristol Brass Corp., Bristol, Conn. Reviewing ASA's "record of solid growth and accomplishment" as it completes its thirty-fifth year, Mr. Gay noted that the ASA membership totals 114 societies and organizations, and 2,337 companies.

In the past year the ASA has approved 59 new standards and revised 215, bringing the total number of standards now in use to 1,350. Of these, 182 have been developed for civil engineering and construction alone.

Professor Magnel to Visit United States

Belgian expert on prestressed concrete, Prof. Gustave Magnel, M. ASCE, plans to spend two weeks in the United States next February to inspect engineering works. During his visit he will address the Prestressed Concrete Convention in Toronto, Canada, January 28-30. Other engineering groups he is expected to address are the Boston Society of Civil Engineers, Boston, February 2; Drexel Institute of Technology, Philadelphia, February 3; the Fifth Naval District, Norfolk, February 5; and the Louisiana Section of the Society and Tulane University, New Orleans, February 8.

Titanium Plant to Be Built in Tennessee

Award of a contract for construction of the titanium facilities being designed for Cramet Inc., at Chattanooga, Tenn., to the Turner Construction Co., of New York, is announced by the Vitro Corporation, which is handling overall project management and engineering of the new plant. The project, which will increase domestic production of titanium sponge by 6,000 tons annually, is scheduled for partial production in 1954 and full production a year later. It is being built under agreement between the General Services Agency and Cramet, a subsidiary of the Crane Co., of Chicago. The major part of the titanium output will be channeled toward U.S. Air Force requirements.

St. Lawrence Power Plan Authorized by Eisenhower

Authorization for New York State to join Ontario in building the St. Lawrence River power project has been given by President Eisenhower, who has designated the New York State Power Authority official United States participant in the $316,000,000 power project. The Authority had previously received a license from the Federal Power Commission empowering it to construct the project and to control disposition of the American share of the power generated. However, three agencies are petitioning the U.S. Circuit Court of Appeals for the District of Columbia asking the court to review the FPC order.

Following issuance of the executive order clearing the way for the project, John E. Burton, chairman of the New York State Power Authority, announced selection of the engineering firms for the project—Sanderson & Porter, of New York, and Charles T. Main, Inc., of Boston. Both are widely experienced in the design and construction of electric power facilities. Canada had already selected the Hydro-electric Power Commission of Canada as its representative on the project.

Located in the International Rapids section of the St. Lawrence near Massena, N. Y., the project will include a dam and powerhouses for the two countries across the river at the lower end of Barnhart Island, a dam at the upper end of the island, and a control dam further upstream to regulate the flow from Lake Ontario. The detailed plans for these power and navigation structures, made by the Army Corps of Engineers in 1942, are being brought up to date by three consulting engineers—Constantine Belousow and Franklin J. Leerburger, of New York, and Asa George, of Ithaca, N. Y. Financing of the project will be handled by four investment banking firms.

Canada has announced that it will proceed alone with development of a seaway on the Canadian side of the river.

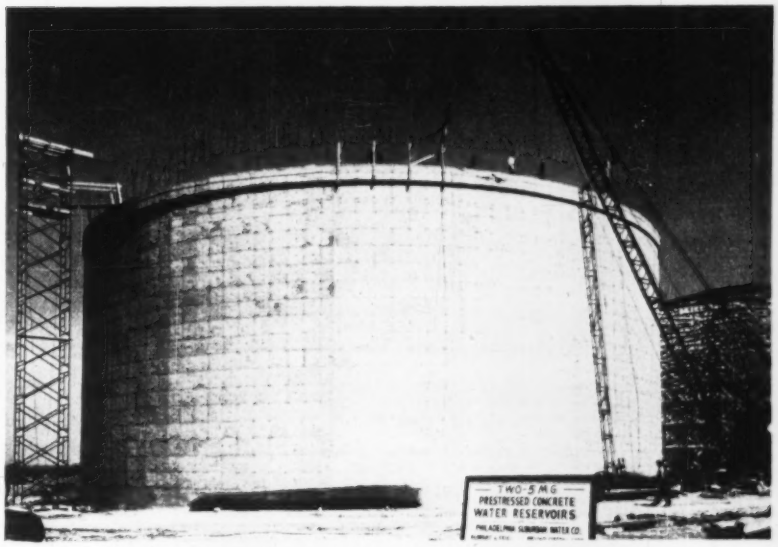
Articles on the St. Lawrence power project appeared in CIVIL ENGINEERING for November 1949 and March 1950.

American Welding Society Opposes Licensing Welders

The American Welding Society has suggested that a resolution adopted at a recent meeting of its board of directors be given publicity as representing an important statement of its policy. The resolution reads:

"Under no condition shall the American Welding Society issue a certificate for license to a welder. The Society shall oppose any plan for the certification or licensing of welders that denies a fabricator the privilege of qualifying his own welders."

Prestressing Used for Philadelphia Water Tank Project



Construction of two domed prestressed concrete water tanks, with a capacity of 5,000,000 gal each, has just been completed by the Preload Central Corp. at North Wayne, Pa., for the Philadelphia Suburban Water Co. Designer of the tanks, which are 126 ft in dia and 54 ft 4 in. deep, was the Preload Company, Inc. Albright & Friel, of Philadelphia, served as consulting engineers for the owner. Erection of the tanks, from the initial excavation to the application of the final layer of pneumatic mortar, took 25 weeks. Concrete requirements for each tank were 1,934 cu yd, including all pneumatic mortar for dome and wall, as against 3,500 cu yd which would have been needed for a conventional reinforced concrete tank of the same capacity and dimensions.

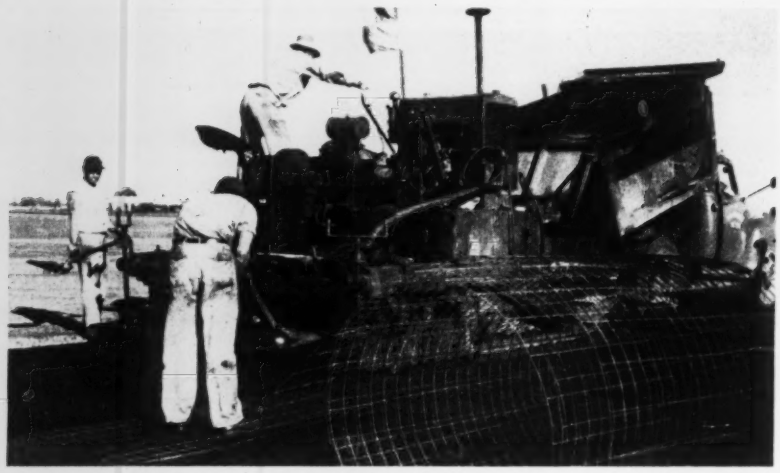
Better Utilization of Manpower Studied

Ways of improving utilization of the country's scientific and professional manpower were studied on a national scale at a recent five-day conference sponsored by the National Manpower Council on Columbia University's Harriman Campus at Harriman, N. Y. Sixty-six leaders in the fields of engineering, education, medicine, science, industry, government, and the armed services from all over the United States took part in the conference, which sought practical means of carrying out the Council's recent recommendations on manpower utilization reported in a book entitled *A Policy for Scientific and Professional Manpower*. This study, published by the Columbia University Press, was presented by Council members to President Eisenhower in May.

The findings of the engineering group, reported to the conference as a whole, noted that "improved utilization can be defined as any step which increases the quantity or quality of goods and services produced with given amounts of capital, using the same number of technological personnel." It was the consensus of the group that improved utilization begins with improved training, "not only in the colleges and on the job, but also in the elementary and secondary schools." On the job, improved utilization can be achieved "by keeping technologically trained people at the technological jobs for which they are best fitted through incentives in the form of status, recognition, and money awards...." Efforts to improve utilization, it was concluded, "must distinguish among what can be accomplished to secure immediate gains, what may yield results only after some investment of time and money, and what changes are fundamental and long range in character."

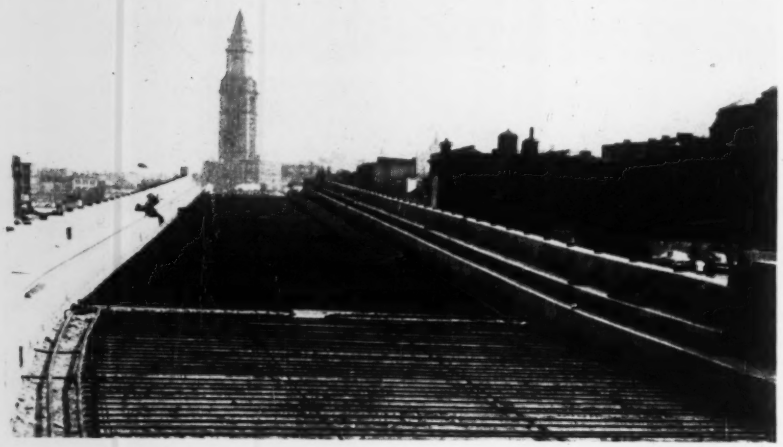
The engineering group was under the chairmanship of Frank W. Pierce, a director of the Standard Oil Company of New Jersey and a member of the Council. James D. Zellerbach was Council chairman. The entire Conference proceedings will be published by the Columbia University Press early next year. Engineers Joint Council was represented by T. A. Marshall, Jr.

Welded Wire Fabric Used in Airport Paving



First known use of welded wire fabric in asphalt runway topping is being made on the main runway of the Indianapolis Airport. The paver is spreading a second course of coated aggregates over the fabric. A worker (back to the camera) helps to hold the fabric flat by standing on it. The fabric is positioned along the transverse expansion joints in the existing portland cement concrete runway for the purpose of preventing formation of "strike-through" cracks in the resurfacing and eliminating joint maintenance. It is usually laid in sheets, longitudinally in the direction of the paver. Fabric is made of No. 10 gage cold-drawn steel wire, spaced 3 in. longitudinally and 6 in. transversely Photo courtesy "Indianapolis Times."

Boston Aerial Highway Incorporates Snow-Melting System



Installation of heating pipes in access ramps of the $25,000,000 Boston Aerial Highway, now under construction, is designed to protect motorists from the hazards of skidding and to eliminate a major cause of traffic congestion in winter. To assure dry road surfaces in cold weather, wrought-iron pipe grids are being embedded in each of seven ramps serving the new highway. More than 200 tons of $1^1/_2$-in. pipe, welded into 10 by 22-ft grids, is arranged in series and buried in the concrete pavement. Each ramp has its own snow-melting system with pump, heat exchanger, and pipe units. To operate the systems, steam supplied by the Boston Edison Company is fed to the heat exchangers and water, mixed with anti-freeze, is circulated through the heat exchangers and pipe networks. Each system is designed for either automatic or manual operation, or for a combination of both. In the planning stage for a number of years, the Boston Aerial Highway was designed by Fay, Spofford & Thorndike and the Commonwealth of Massachusetts Bridge Department.

Contract for Long Beach Bridge Project Awarded

Construction of two bridges providing eight lanes of traffic to replace the existing narrow bridge across Reynolds Channel between Long Beach and Island Park, N.Y., will get under way following recent award of a $4,726,052 low-bid contract to the Merritt-Chapman & Scott Corp. Designed to end summer traffic jams on the Long Beach route to the Island resort, the project will consist of twin bridges with twin leaf bascule spans providing 100-ft horizontal clearance and 29-ft vertical clearance when closed. Each will have a 40-ft roadway with a 6-ft walkway on one side, and will be 820 ft long from abutment to abutment.

Charles V. Smith, deputy commissioner of highways and general engineering of the Nassau County Department of Public Works, will be in charge of the work. The J. E. Greiner Co. will serve as consulting engineers on the project.

Task Force Will Study Federal Role in Power

A 24-member task force has been appointed to study federal activities in the water and power resources field by former President Herbert Hoover, Hon. M. ASCE, chairman of a new Commission on Government Reorganization. Retired Rear Admiral Ben Moreell, Hon. M. ASCE, now chairman of the board of the Jones & Laughlin Steel Corp., will head the task force that includes a number of engineers as well as such public figures as former Secretary of the Navy Charles Edison, two former governors, and a Congressman.

ASCE members on the board, in addition to Admiral Moreell, are Carey H. Brown, Scottsville, N.Y., James P. Growdon, Pittsburgh, Pa.; Julian Hinds, Los Angeles, Calif.; Past-President Wesley W. Horner, St. Louis, Mo.; Past-President Malcolm Pirnie, New York, N.Y.; William D. Shannon, Seattle, Wash.; and Royce J. Tipton, Denver, Colo. Charles D. Curran, M. ASCE, Washington, D. C., has been selected to direct the staff work for the group (page 95).

Mr. Horner served as chairman of the National Water Policy Panel of Engineers Joint Council, which was created in 1947 at the instance of ASCE, to investigate and report "upon the several elements affecting the orderly and economical development of the water resources of the country, with recommendation as to legislation and administrative organization necessary to effect the ends sought." The 230-page report, prepared by the Panel, was released in July 1951.

The proposed survey, which is considered one of the important tasks of the new Hoover Commission, will include a study of developments in navigation, flood control, and reclamation.

J. R. Perry Is New Head of Bureau of Yards and Docks

John R. Perry, rear admiral, CEC, U.S. Navy, took office on November 3 as chief of the Bureau of Yards and Docks and chief of Navy Civil Engineers, following Presidential confirmation of his appointment. He succeeds Rear Admiral Joseph F. Jelley, Jr., M. ASCE, whose appointment as director of construction in the office of the Assistant Secretary of Defense was noted in the November issue (page 102).

A graduate of the U.S. Naval Academy at Annapolis, Admiral Perry holds two civil engineering degrees from Rensselaer Polytechnic Institute. He has served at Naval Stations in the Philippines, Cuba, and Florida, and has been Director of Administration and Personnel and Assistant Chief for Operations in the Bureau of Yards and Docks and Public Works Officer at the U.S. Naval Academy. He has been awarded numerous decorations and citations for his services in World War II in the Pacific Theater which included "the tremendous task of recruiting, organizing, training, equipping, and distributing to outlying bases the Navy's Construction Battalions." His most recent assignment has been as director of the Pacific and Alaska Division of the Bureau of Yards and Docks, with headquarters at San Francisco.

J. A. McHenry, Captain, CEC, U.S. Navy, took office as Deputy Chief of the Bureau on November 16. A graduate of Villanova College with a degree in civil engineering, Captain McHenry has been on active duty in the Navy since 1941. His honors for wartime service in the Pacific Theater include citations for material contributions "to the efficiency of his unit in constructing extensive fleet facilities in the Hawaiian area" and for "invaluable assistance in the reorganization of three Naval Construction brigades."

Engineers Invited to Enter Architectural Exhibition

Announcement of its 1954 national Gold Medal Exhibition is made by the Architectural League of New York. The annual exhibition is the 57th to honor outstanding work in architecture and allied fields, including engineering, by award of gold and silver medals and honorable mentions.

Work in engineering to be eligible for an award must show some visual aspect of building, either structural, mechanical, or electrical, and be characterized as a special or unusual contribution in design to the progressive development of structures. Preliminary submissions, consisting of photographs only, are open to December 31, 1953. A circular of information may be obtained from the chairman of the Engineering Committee on Selection, Peter A. Strobel, M. ASCE, 70 West 40th Street, New York 18, N. Y.

Texas Causeway Nears Completion

Scheduled for completion in February 1954, this concrete causeway will link Port Isabel, Tex., with Padre Island, a recreational area in the Gulf of Mexico. The structure stands on concrete pile bents with cast-in-place caps. The deck is typical Texas rib-and-arch design. Bents are 30 ft 8 in. center to center. Cost of the 6,700-ft structure will be $2,500,000. Alfred Tamm, A.M. ASCE, was design engineer, with Parsons, Brinckerhoff, Hall & Macdonald consultants. The structure was built by Heldenfels Bros. Cameron County is financing construction of the project.

Pittsburgh Area Plans Sanitary Clean-up

Pittsburgh is taking an active part in planning an $85,000,000 sewerage project, which will also serve 64 surrounding communities. Part of a clean-up program of the Allegheny County Sanitary Authority, the project involves 63½ miles of intercepting sewers, 32 miles of which are to be in deep tunnel, and a 150-mgd pumping station and treatment plant.

Conforming to requirements of the Pennsylvania Department of Health and the Ohio River Valley Water Sanitation Commission, the plant is designed to reduce biochemical oxygen demand by 50 percent. To accomplish this reduction the treatment plant will include mechanically operated racks, grinders for screenings, aerated grit chambers, pre-aeration for 45 min, two hours of sedimentation, and chlorination of the effluent. After concentration of sludge and withdrawal of subnatant liquids, the sludge will be mixed with fine coal to support combustion and incinerated. Laboratory and pilot plant tests indicate that this new process for sludge disposal will result in considerable saving in initial construction and operating costs over conventional digestion methods.

The Allegheny County Sanitary Authority will complete its work early next year. Approximately $52,000,000 of construction work in the form of plans and specifications is in the hands of the Pennsylvania Department of Health for review and approval. When the plans are approved, the city has the option of electing the Sanitary Authority to carry out the construction or appointing another sewage agency in its place. John F. Laboon, M. ASCE, is chairman of the Authority.

Army Engineers' Dam In Texas Dedicated

Lavon Dam, a $11,200,000 Corps of Engineers' flood control and water conservation project in Texas, was dedicated on October 27 in ceremonies headed by Representative Sam Rayburn. Authorized by Congress in 1945, the 9,500-ft-long earth dam across the East Fork of the Trinity River is part of a comprehensive plan to control floods and conserve water in the heavily populated Dallas-Fort Worth area. In addition to its flood control features, the project will store 100,000 acre-ft of water for ten North Texas municipalities. Dallas, 30 miles distant from the dam, is considering joining the water district to assure a future water supply for its rapidly growing metropolitan area.

Allis-Chalmers Starts Operating Buda Company

The Allis-Chalmers Manufacturing Co. has officially assumed operation of the Buda Co., 72-year-old Harvey, Ill., firm, which produces 23 sizes of diesel engines and 20 sizes of natural gas, butane and gasoline engines, ranging from 5 to 516 hp and widely applicable in the construction, trucking, and other fields. Another major field in which Buda is prominent is the manufacture of earth-boring machines. The company will be operated as a division of Allis-Chalmers, with Ralph K. Managan, president since 1950, in charge.

New Orleans Host to 1953 APWA Congress

More than 1,200 public works officials, their wives and associates gathered in New Orleans the last week in October to listen to discussions about the latest methods for keeping America's cities clean and comfortable, keynote theme of the American Public Works Association's 1953 Congress and Equipment Show. On exhibit were some of the latest developments now being marketed by equipment manufacturers.

Featuring the opening session of the Congress was an address by Val Peterson, Federal Administrator of Civil Defense, entitled "The Backbone of Civil Defense." The remainder of the initial session was devoted to a thorough discussion of "Composting as a Method of Garbage Disposal." Noting an increase in interest in this age-old method of garbage disposal, John R. Snell, of the department of civil engineering at Michigan State College, cited the fact that until six months ago, "about 40 percent of the municipal garbage in the United States had been fed raw to hogs. At this time the rapid spread of a serious hog disease, similar to the foot-and-mouth disease in cattle, caused by viscular exanthema, spread rapidly through most of the country."

The speaker went on to state that, "Hundreds of municipalities have their backs to the wall and are faced with the problem of finding an alternate method of disposing of their wastes." Mr. Snell felt that with the impetus of necessity, composting will soon take its place among man's many useful sciences, not only in solving the problems of waste disposal but in making these vast quantities of waste available to our organically depleted soils."

In a paper on incinerator design and operation William S. Foster, engineering editor of *The American City*, criticized the use by some cities of sanitary landfills in connection with incinerators. "If a municipality has plenty of space for a landfill, then it will be money ahead to use that method. Municipalities use incinerators because land costs are high and disposal areas are at a premium," he said.

Albert G. Wyler, New Orleans city engineer, was general chairman of the four-day congress, and Carl Schneider, New Orleans consultant, presided as moderator. Newly elected president of the organization is Milton Offner, secretary of the Board of Public Works, Los Angeles, Calif. Mr. Offner succeeds Allan H. Rogers, superintendent of public works, Garden City, N. Y.

Two Contractors to Receive Moles Awards

J. Rich Steers, of New York, and Glenway W. Maxon, of Dayton, Ohio, have been named as the 1954 member and non-member recipients of the awards given annually by the Moles for "outstanding achievement in construction." The announcement was made at a Charter Members' Night dinner meeting of the organization, New York society of leaders in the heavy construction industry. When the awards are presented —at a banquet at the Waldorf-Astoria next February 3—the two winners will be the fourteenth pair honored in a series that started in 1941 and numbers among its recipients Herbert Hoover, Robert Moses, Admiral Ben Moreell, and Gen. Brehon B. Somervell.

As president of the New York construction firm of J. Rich Steers, Inc., Mr. Steers has directed construction of a number of Navy shipyards and drydocks and of sections of the East River Drive. Four large postwar assignments in the Mediterranean area have included the rehabilitation of the three main harbors of Greece and the Corinth Canal.

Dams, locks, and bridges, principally on the Ohio and Mississippi rivers and their tributaries, have figured prominently in Mr. Maxon's work, as president of the Maxon Construction Co., of Dayton, Ohio, which he formed in 1928. During its quarter of a century of existence his firm has completed approximately $700 million worth of construction, and at the start of the current year had obligations involving another $200 million worth. The citation honoring Mr. Maxon makes special mention of the success his company has had in the sharing of earnings with personnel at all levels.

AEC Programs Construction of Full-Scale Power Reactor

The Atomic Energy Commission announces that it has contracted with Westinghouse to build a 60,000-kw industrial power reactor, under the direction of Dr. Lawrence R. Hafstad, director of the Commission's Reactor Development Division. In announcing this decision, AEC Commissioner Thomas E. Murray said that this first reactor may be located at or near one of the AEC gaseous diffusion plants so that the power can be used to supply a part, a very small fraction, of the huge power requirements for such a plant.

Although Rear-Admiral H. G. Rickover, Navy reactor expert, has been assigned immediate responsibility for the Commission's first large reactor, Mr. Murray noted that "the only Navy aspect which the Admiral will bring to this work is his title," since the new reactor is to be a completely civilian venture. It is expected the reactor will be in operation in three or four years.

Decision to build a full-scale commercial power reactor is based on the belief of the AEC that its scientists and engineers have "much to learn that could only be learned by building and operating." In the near future the AEC expects to propose construction of different types of reactors in order to explore other avenues of approach to the generation of nuclear power.

New Screw Thread Standards Proposed

A new tentative screw thread standard — Section 6 of the Proposed American Drafting Standards Manual—is being distributed to industry and others for comment by the Standards Department of the ASME. The general purpose of the new section is to present recommended drafting practices for the delineation and specification of Unified and American Screw Threads as given in the American Standard ASA B1.1. Its scope includes thread representation; thread series and thread classes; thread selection; thread specification; and thread dimensioning.

Copies are available for study and comment from D. M. Schackelford, Standards Administrator, American Society of Mechanical Engineers, 29 West 39th Street, New York 18, N.Y.

San Francisco Builds Second Parking Garage

To further relieve its parking problem, San Francisco is building a new underground multi-story garage under St. Mary's Square, which will make it the first city in the country to have two underground parking garages. The new structure will have a parking capacity of 1,025 automobiles, compared with the 1,700-car four-story Union Square Garage, which was built in 1942. Located on the outskirts of Chinatown and close to the financial district, the present five-story structure will serve sightseers as well as the business district.

A joint project of the City and County of San Francisco, the San Francisco Parking Authority, and the Recreation and Park Commission, the garage is being built at a cost of $2,100,000. It was started last March and is scheduled for completion within a year, though indications are that part of it will be ready for use as early as this December. John J. Gould, M. ASCE, consulting engineer, is the designer, and Haas and Haynie the general contractors.

AEC Cancels Construction of Spoon River Plant

Construction of the projected Spoon River explosives processing and assembly plant near Macomb, Ill., has been cancelled by the U.S. Atomic Energy Commission. The action was taken as a result of technical developments which are expected to enlarge the output of already existing plants turning out the same products as would have come from the projected new plant. According to an announcement from the AEC, it has been established that the future requirements of the atomic energy program in the field can be supplied by present plants.

Estimated savings in construction and engineering costs will be some $26,000,000 in addition to about $4,000,000 in start-up cost and $3,000,000 a year in recurring operating costs. Negotiations are under way with the Fluor Corporation, Ltd., of Los Angeles, the architect-engineer, and Thompson Products, Inc., the operating contractor, for termination of their contracts. Payment for work already accomplished and costs of contract termination are expected to reach $2,000,000.

New Device Automatically Analyzes Pavement Surface Characteristics

A new type of automatic road-surveying equipment and pavement surface analyzer has recently been developed under the name of "clinodograph." The inventor is Dr. Ingr. Raymond F. Simonin, whose initial objective was to devise an instrument capable of accelerating to a considerable extent road-surveying operations through substitution of automatic recording of profiles and typical characteristics of pavement surfaces for the tedious work of field operations and data processing in the office.

Electrical, optical, and other types of delicate devices have been avoided. The particular curves corresponding to the type of characteristics desired by the operator are directly amplified and transcribed to the graph paper (as shown in one of the photos), through purely mechanical transmissions actuated by the vehicle and in direct correlation to the development of the track followed by the wheels.

In the case of profile recording, the instrument performs the mechanical integration of the elementary quantities δ_v and δ_H, which define the characteristics of the grade surface, as projected on a succession of vertical planes tangent to the horizontal projection of the trajectory followed by the machine.

The mechanism by which the integration is performed includes a pendulum and a planimeter. The planimetral disk is scanned by a specially designed caster. Its motions are mechanically transmitted to a stylus which transcribes directly to the graph paper and at a chosen scale, the curve representing pavement profile. The type and size of the exploratory wheel in contact with the grade are chosen according to the type of characteristic to be recorded.

The machine is built as a trailer, with the chassis supported rigidly by four wheels of standard motorcycle type. The mechanism is enclosed in a watertight housing and protected from the weather.

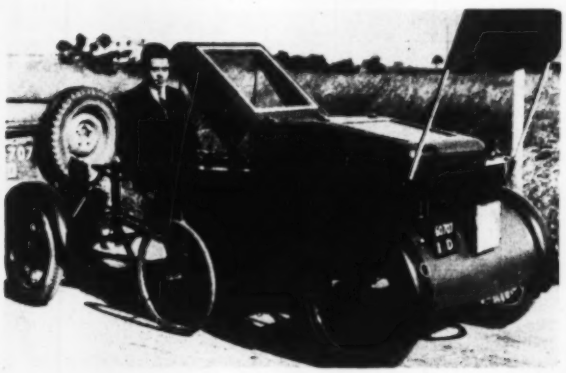
Speed of the vehicle varies with respect to the type of characteristics to be obtained—about 4 miles per hour for longitudinal profile for instance, less for geometrical roughness. On center-line profile surveys, the errors of closure have been reported to be less than 1:10,000.

For limited operations, such as are carried out on airfield aprons, taxiways and runways, and when automatic integration is not imperative, a simplified "clinodograph" has been evolved. This machine is operated by hand. A simple device enables the automatic recording of the characteristics in plan of the front wheel trajectory.

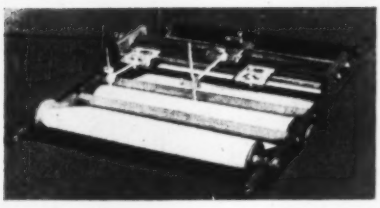
The practical use of the recorded profiles (typical ones are shown in Fig. 1) covers the whole field of pavement studies from the standpoint of safety and comfort of traffic and adequate maintenance. The "clinodograph" allows engineers to set standards of performance, to detect and measure scientifically and accurately all types of defects of pavement surfaces, and to prepare maintenance programs accordingly. Little expense and a minimum of time will be involved.

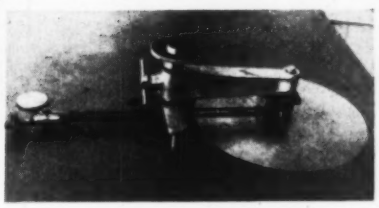
As an example the uneveness curve (Curve B in Fig. 1) permits an accurate estimate to be made of the volume of materials involved in resurfacing. This is done by a simple graphic integration of the areas between the recorded profile and the desired finished grade.

All informations as to the availability of the "clinodograph" in the United States can be obtained from Intercontinental Technical Enterprises, Inc., 20 East Jackson Boulevard, Chicago 4, Ill.



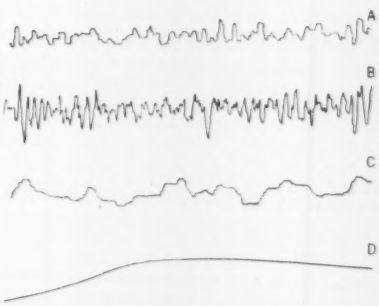
Machine is built as a trailer, with the chassis supported rigidly by four wheels of standard motorcycle-type design. The mechanism is enclosed in a watertight housing.



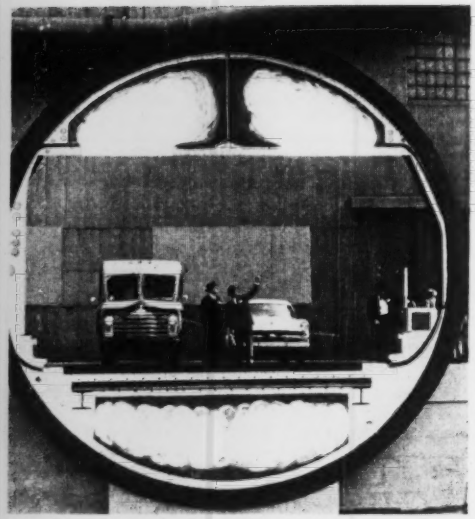


Planimetral disk is scanned by a specially designed caster, shown at right. Motions of caster are mechanically transmitted to a stylus (left-hand view), which transcribes directly to the graph paper, and at a chosen scale, the curve representing pavement profile.

Fig. 1. Examples of profiles recorded by the "clinodograph" are indicated here.



Curve	Representation (Geometrical) of:	Scales: Abscissa	Scales: Ordinate
A	Rolling characteristic	1/500	1/1
B	Uneveness characteristic (for resurfacing)	1/500	1/1
C	Roughness	1/10	1/1
D	Grade line	1/500	1/100



Lining for Third Tube of Lincoln Tunnel Fabricated

Engineers of the Port of New York Authority, which is building a $90,000,000 third tube for the Lincoln Tunnel between Manhattan and New Jersey, visit the plant of the Bethlehem Steel Co. at Bethlehem, Pa., to watch the manufacture of segments for the big vehicular tunnel. The outside shell (shown here) consists of iron segments. The interior is a papier-mache simulation of other details. In the center of the roadway are J. M. Sylvester (left) general manager of the Bethlehem plant, and John M. Kyle, M. ASCE, chief engineer of the Port of New York Authority.

Contract Let for Alaska Military Pipeline Project

Award of a joint-venture contract for construction of a 610-mile, 8-in. military pipeline from Haines to Fairbanks, Alaska, is announced by the Army Corps of Engineers. The three firms uniting in the joint venture, are Williams Brothers Co., Tulsa, Okla.; McLoughlin Inc., Great Falls, Mont.; and the Marwell Construction Co., Vancouver, B.C. The joint venture was low bidder for the job, at $29,001,287.50.

A part of the Alaska defense program, the pipeline project is designed to provide a safe supply of fuel direct from the seaboard to military and air bases in the interior. It is scheduled for completion by September 1955.

General Motors Acquires Euclid Road Machinery Co.

With recent acquisition of the stock of the Euclid Road Machinery Co., General Motors will extend its truck lines into the heavier off-the-road types of vehicle, for which it now supplies diesel engines and torque-converter transmissions. Such a program of product extension has been under consideration by General Motors for some time. The Euclid line includes rubber-tired rear and bottom dump trucks ranging in size from 10 to 50 tons, and scraper carriers in sizes up to 30 tons.

The Euclid Road Machinery Co., which has its offices and plant in Cleveland, will be operated as a wholly owned subsidiary. The present management will continue under the direction of Raymond Q. Armington, president and general manager.

N. C. Neare's COLUMN

R. ROBINSON ROWE, M. ASCE

"It may seem unseasonable in December," said Professor Neare, "to recall last summer's picnic of the Engineers Club, but we still haven't answered the challenge of Titus Wadhouse to minimize the work of equalizing the spaces between the tables. Originally the spaces were 10, 16, 8, 11 and 15 ft. If all were made 12 ft without moving the end tables, the fifth had to move 3 ft and 3 others 2 ft, making 108 in. in all. Minimizing the greatest shift of any table made more work, 116 table-in., and led to the challenge. Sounds easy, doesn't it Joe?"

"It is easy," exclaimed Joe Kerr. "At first I tried to make it hard by the method of least squares and got an answer of 105.6 in., but when I checked it on your nomograph, I saw how to reduce it even more. Since every isopleth intercepts on 6 scales the respective shifts of 6 tables for an equalization, I just moved a straightedge around until the total of the 6 intercepts was least. I finally found one that added to exactly 100, which is the kind of round numbers you like, so I'm betting on it."

"Well I'll be a one-eyed jack," muttered Cal Klater.

"Meaning," taunted Joe, "that you found the same answer by an elegant and rigorous 4-dimensional analysis?"

"No, it was a 3-D show. If x and y are the shifts of the end tables and z the total of all shifts for the corresponding equalization, the 3-dimensional graph is a surface made up of 22 plane facets like an inverted multi-gabled roof. It could be called a geometric sink, with the answer, of course, at the sink-hole. I plotted enuf of it to find this point, checking your answer. It was at the vertex of 4 facets but, and this is more important, it was at the junction of 2 edges or valleys, and each valley corresponds to the zero point on one of the nomograph scales. So trial of each pair of zeros on the nomograph would constitute a rigorous analysis."

"Which is one reason I gave you the nomograph," explained the Professor. "The problem is far from trivial, as anyone knows after trying to minimize the sum of the absolute values of a set of variates.

"Next, if you've never seen a hydromagnetic spherometer, I'd like to describe it and give you an example of its work. Essentially it's a graduated glass cylinder with an electromagnet in its base and an overhung spring balance suspender to support specimen spheres. In a typical test, the cylinder was filled with water to the 12-in. mark, a hollow metal sphere was hung on the suspender, the balance read, and the sphere lowered into the water until buoyancy reduced the balance reading to zero. Water had risen to the 14.5-in. mark and nadir of sphere was level with the 8.5-in. mark. Then the magnet was switched on, pulling nadir down to the 3-in. mark and forcing water up to 28 in. A final reading of the balance gave tension in the suspender. I might ask what will happen now if the magnet is switched off, but I'd rather have you compute the effective specific gravity of the sphere."

[Kerrs and Klaters were: Stoop (John L.) Nagle, Richard Jenney, G. I. (Morton) Raff, M. L. Pei, Flo Ridan (Charles G. Edson), S. K. Rueball (Keith Jones), Sauer Doe (Marvin Larson), Thatchrite (Guy C. Thatcher). Last-minute September Klaters were Julian Hinds, R. E. Philleo and Emerson J. Boyd, Jr.]

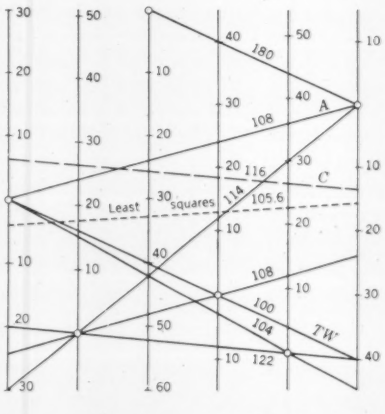


Fig. 1. Titus Wadhouse's tightwad scheme shifted four tables a total of only 100 in.

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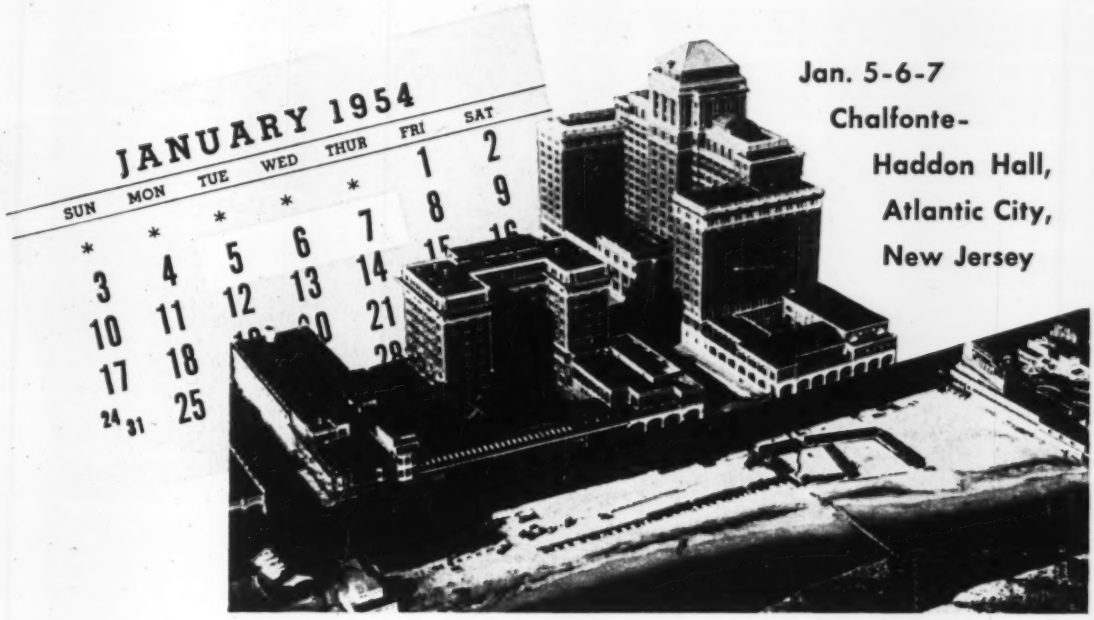

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★ **HEAR** *Nationally-Known Speakers and Highway Authorities*

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★ **ENJOY** *Superb banquet—gala entertainment—Special events for ladies*

AMERICAN ROAD BUILDERS' ASSN. 1902

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AMERICAN ROAD BUILDERS' ASSOCIATION

WORLD CENTER BLDG., WASHINGTON 6, D. C.

DECEASED

Former Director Lewis Gram, Dies

Lewis Merritt Gram (M. '16), age 77, professor emeritus of civil engineering at the University of Michigan, died at Ann Arbor, Mich., on November 10. A 1901 graduate of the university, Professor Gram was employed successively in the Toledo offices of the American Bridge Co., the Massillon Bridge Co., and A. Bentley & Sons Co., and maintained a private practice in Toledo and Cincinnati before entering the teaching profession. Appointed professor of civil engineering at the University of Michigan in 1912, he advanced to the chairmanship of the department by 1928, serving in that capacity until his retirement in 1946. Active in ASCE affairs, Professor Gram was elected Director for the 1947-1949 period, but resigned because of ill health before the completion of his term.

Lewis M. Gram

Carl Conrad Cooman (M. '43), age 61, connected with the Rochester Gas and Electric Corp., since 1923 and in charge of their structural design operations since 1935, died in Rochester, N. Y., on October 7. Prior to 1923, Mr. Cooman was employed by the Portland Cement Association; C. H. Sage, of Batavia, N. Y.; and the Rochester Bureau of Municipal Research. He served as president of the Rochester Section in 1934 and was chairman of the Section's Qualifications Committee at the time of his death. He was a graduate of Cornell University.

William Harrison Crawford (M. '23), age 70, for the past 12 years engineer of design for the Transmission and Distribution Division, U. S. Department of Public Works, Bureau of Water, at Philadelphia, Pa., died on October 1. A specialist in the design and construction of water supply projects, Mr. Crawford's experience had been with the American Pipe & Construction Co., Philadelphia (1905-1929); the Federal Water Service Co., New York; the Public Service Commission of West Virginia; and the Pennsylvania State Flood Control Board. He studied at Drexel Institute and the University of Pennsylvania.

Joseph Herbert Davies (M. '40), age 51, consulting engineer of Long Beach, Calif., died on October 7. A graduate of Ohio State University, he had worked with the Ohio State Division of Highways prior to going to California in 1927. From 1927 to 1933, he was a structural engineer in the Long Beach City Building Department. He was in charge of the engineering construction work after the 1933 Long Beach earthquake. From 1933 until his death, Mr. Davies had his own private consulting engineering practice. His work included many military projects, bridge construction, commercial, industrial and civic buildings, pipe lines and mechanical projects.

James Francis Downey, Jr. (A.M. '26), age 56, consulting engineer of White Plains, N. Y., and president of James F. Downey & Staff, Consulting Engineers, died at his home in White Plains on October 4. For several years, Mr. Downey was connected with the Charles E. Bedaux Co., of New York City, and was instrumental in organizing the firm, American Associated Consultants, Inc., consulting industrial engineers of New York. He was an alumnus of the Massachusetts Institute of Technology.

Thomas Jefferson Stone Edelen (A.M. '09), age 76, from 1918 to 1931 president of Edelen & Co., of Philadelphia, Pa., and since 1931 president of Edelen & Boyer Co., died on August 24. He had been a member of the firm Edelen-Kilvert Co., Winnipeg, Canada, and practiced in Milwaukee briefly before going to Philadelphia. Mr. Edelen attended Lehigh University.

Henry Jacob Grathwol (M. '37), age 67, retired engineer of Silver Spring, Md., and an alumnus of Rensselaer Polytechnic Institute, died on July 4. He had been connected with the New York, West Virginia, and Pennsylvania state highway departments, and for ten years wih the U.S. Bureau of Public Roads in Washington, D.C. From 1942 until he retired in 1948, Mr. Grathwol was with the Bureau of Yards and Docks, Washington, D.C.

Harry Parker Hammond (M. '22), age 68, who retired in 1951 as dean emeritus of the school of engineering at Pennsylvania State College after 14 years of service, died at Bellefonte, Pa., on October 21. Before going to Penn State, Dean Hammond had been on the faculties of the University of Pennsylvania, Lehigh University and the Polytechnic Institute of Brooklyn (1913-1937). His career as a practicing engineer included work with the American Bridge Co., the New York City Board of Water Supply, and the Miami Conservancy District. An active member of the American Society for Engineering Education, Dean Hammond had been vice-president and president, and was recently named one of the society's first honorary members. He was also instrumental in the organization of the Engineers Council for Professional Development. Dean Hammond held degrees from the University of Pennsylvania, the University of Vermont, and the Case School of Applied Science.

Harry P. Hammond

James Buchanan Hays (M. '30), age 64, foundation authority and expert on river development and dam construction, acting as consultant to Morrison-Knudsen since 1947, died in his home town, Summit, N. J., on October 24. Most recently Mr. Hays had participated in the firm's operations in Afghanistan and British Columbia. Earlier he served as construction engineer for the Tennessee Valley Authority on the Chickamauga and Kentucky dams and as project engineer on the Watauga Dam. He left the Authority in 1942 for a five-year period with the Palestine Survey Commission. He was an alumnus of the University of Idaho.

Scotland G. Highland (A.M. '39), age 74, secretary, general manager, and senior engineer of the Clarksburg (W. Va.) Water Board, and a resident of West Milford, W. Va., died on October 25. Associated with the Clarksburg utility continuously since 1906, he was named secretary, treasurer and senior engineer in 1912 and senior engineer in 1940. Mr. Highland attended West Virginia University.

Franklin Davinport Howell (M. '01), age 86, consulting engineer of Los Angeles, Calif., and special assistant to the president of the Pacific Electric Railway, died on September 10. Engaged in private practice in California, Arizona, and New Mexico since 1906, he acted as consultant at various periods to the cities of Pasadena and Los Angeles. Mr. Howell served as chief engineer for the Board of Public Utilities and as a member of the Board of Water and Power Commissioners for the City of Los Angeles. In 1923 he was president of the Los Angeles Section.

William Edward Jones, Jr. (A.M. '23), age 66, assistant to the chief engineer of the Iowa State Highway Commission at Ames, Iowa, died on October 22. Continuously connected with the highway department since his graduation from Iowa State College in 1913, Mr. Jones advanced from district engineer and engineer of design to the position he held at the time of his death.

Rutger Harold Kindberg (J.M. '51), age 28, cadet engineer for the Providence Gas Co., Providence, R.I., died on October 5. Mr. Kindberg had been with the firm since his graduation in June 1951 from the University of Rhode Island, with the B.S. degree in civil engineering.

George Alfred Lund (M. '38), age 84, New York City engineer, who retired in 1927 following 21 years as construction manager for Post & McCord, New York building contractors, died on June 11. Before joining Post & McCord, Mr. Lund worked for several structural bridge companies including the Mt. Vernon Bridge Co., the Pittsburgh Bridge Co., the Boston Bridge Works, and the American Bridge Co. He was an alumnus of Yale University.

Harry Aaron Marmer (M. '30), age 68, who retired in August as assistant chief of the Division of Tides and Currents, Coast and Geodetic Survey, died in Washington, D. C., on November 5. Mr. Marmer had been with the Survey since his graduation from Rutgers University in 1907. In 1920 he was promoted from chief tidal mathematician and chief of the Section of Field Work to the position he held upon retirement. Mr. Marmer is the author of many publications and two books entitled *The Tide* and *The Sea*.

Charles Louis Meyer (M. '19), age 67, founder and chairman of the board of Ceco Steel Products Corp., Chicago, Ill., died at Lake Forest, Ill., on October 5. The inventor of a system of reinforced concrete floor joist construction involving the use of removable steelforms on a rental basis, Mr. Meyer founded the Concrete Engineering Co. (predecessor to the Ceco Corp.) in Omaha in 1912 to promote his invention. He was a graduate of the University of Nebraska, class of 1907, and Columbia University, 1909.

C. L. Meyer

Albert Moyer (Aff. '06), age 82, former president of the Vulcanite Portland Cement Co., New York, N. Y., died in that city on October 13. Mr. Moyer joined the company as manager of sales and director in 1901 following 15 years in the field of railroad engineering. He advanced to the presidency of Vulcanite in 1934, retaining the position until his retirement ten years ago.

William Kurtz Myers (M. '21), age 69, president and chairman of the board of direction of Penn Steel Castings Co., Chester, Pa., died on September 7. During his career Mr. Myers had served in key positions for the Philadelphia Rapid Transit Co.; the International Railway Co., of Buffalo; and Mitten Bank Securities Corp., Mitten Management, Inc., and the Mitten Bank and Trust Co., Philadelphia. Since 1933 he had been associated with the Penn Steel Castings Co. Mr. Myers is a graduate of the State College of Pennsylvania, class of 1905.

John Frederick Partridge (M. '25), age 62, chief of the Construction Plant Branch of the Tennessee Valley Authority, died at Knoxville, Tenn., on October 24. Connected with the TVA since 1934, Mr. Partridge had been assistant construction engineer on the Hiwassee Dam and construction engineer on the Fort Loudoun Dam. For 15 years prior to 1934 he was engaged in hydroelectric and other construction on the Pacific coast and in Brazil. Mr. Partridge was an alumnus of Stanford University and a veteran of both World Wars, retiring in 1947 with the rank of lieutenant colonel.

(*Continued on page 94*)

PERMANENT

pressure-creosoted piles provide low-cost foundations for New York City Housing Project

Arverne Houses, Long Island, New York.
Consulting Engineers: Tuck & Eipel, New York City.
General Contractor: Gull Contracting Company, Brooklyn, New York.
Photo by: Fairchild Aerial Surveys, Inc., Long Island, New York.

THE seven apartment buildings that make up Arverne Houses, a New York City housing project, are resting on Koppers Pressure-Creosoted Foundation Piles. Koppers Piles are specified for many such projects where strength, permanence and low cost are important factors.

The 30 to 50-foot long piles, having 8-inch tips and 12-inch butts, were tested and found to be well within code limits.

You can count on pressure-creosoted piles for strength and long life. The pressure process drives creosote deep into strong timbers. This thorough treatment protects the timber from rot and termites—insures long, dependable service.

For permanent construction, engineering firms throughout the country know that they can rely on pressure-creosoted foundation piles which have been cut off above the water table, with tops thoroughly coated with creosote and capped in concrete. For more information on price and delivery call your nearest Koppers office or write:

KOPPERS COMPANY, INC.
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Pittsburgh 19, Pennsylvania

DECEASED

(*Continued from page 93*)

Erskine Ramsay (M.'25), age 89, since 1925 chairman of the board of direction of the Alabama By-Products Corp., Birmingham, Ala., died recently. Mr. Ramsay began his career in the Carnegie and Frick companies' mines and oven plants, and the Pratt Mines Division of the Tennessee Coal, Iron and Railroad Co. From 1901 to 1925 he was vice-president and chief engineer of the Pratt Coal Co. He was a graduate of St. Vincent College.

Oren Reed (M. '36), age 57, construction engineer for the Tennessee Valley Authority at Chattanooga, suffered a heart attack while working at the Widow's Creek (Ala.) steam power plant project and died on October 29. Mr. Reed joined the TVA engineering staff in 1934 and served as office engineer and assistant construction engineer on the Pickwick Landing Dam; principal civil engineer on the rehabilitation of Hales Bar Dam and powerhouse; and construction engineer on Watts Bar Dam and Fontana Dam. He graduated from Purdue University in 1922, and was with the San Joaquin Light & Power Corp., Fresno, Calif., and the Indiana Department of Conservation, Indianapolis, before going to the TVA.

William Henry Sarver, Jr. (J.M. '52), age 23, assistant dam engineer with the Pennsylvania Department of Forests and Waters at Harrisburg, Pa., died on May 7. Mr. Sarver had been with the department since his graduation from the University of Pittsburgh in 1951.

Robert David Schacherl (A.M. '51), age 34, Bolivian engineer working for the past three years as a bridge engineer for Knappen, Tippetts, Abbett & McCarthy, in connection with the construction of the Cochabamba-Santa Cruz Highway in Bolivia, died in Cochabamba on October 19. He had previously been employed by several local contracting firms and by the Bolivian Development Corp., which participated in earlier phases of the highway project.

Hugh Williams Skidmore (A.M. '24), age 63, since 1919 president of the Chicago Testing Laboratory, Inc., died on October 19. For several years Mr. Skidmore was also a member of the Chicago firm, Craig, Skidmore and O'Brien, Inc., Engineers, specializing in municipal and industrial work. He participated in research projects for the cities of Singapore, Evanston, Chicago, Baltimore, and for the state highway departments of Wisconsin, Iowa and Michigan. He studied at Heidelberg University and Lewis Institute.

Russell Suter (M.'20), age 75, who retired in 1948 as executive engineer and secretary of the New York State Water Power and Control Commission, at Albany, died in that city on October 27. Before joining the Commission in 1919, Mr. Suter had been with the Metropolitan Water Board of Massachusetts; the government of the Philippine Islands; the New York City Board of Water Supply; and the New York State Water Supply and Conservation Commission. He was a graduate of the Massachusetts Institute of Technology.

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- **The Mathews Hydrant is so simply and soundly constructed that there's virtually nothing to go wrong.**
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NEWS OF ENGINEERS

Newcomb B. Bennett, Jr. has been promoted from assistant director to the directorship of the Project Planning Branch of the U.S. Bureau of Reclamation in Washington, D.C. **John W. Dixon,** former chief of the department, is now acting as assistant director.

James R. Bole announces that he will continue the engineering practice of the late **J. H. Davies** without change in personnel and facilities, at the same address—J. H. Davies Building, 730 East Third St., Long Beach 12, Calif. Mr. Bole was employed as chief engineer under Mr. Davies for the past 20 years.

Francis J. Magnuson was the recipient of the Charles Walter Nichols award consisting of $500 and a scroll, at the annual convention of the American Public Works Association held in New Orleans in October (see News Briefs). Mr. Magnuson, who is city engineer of North Mankato, Minn., received the award in recognition of his "outstanding leadership in the rehabilitation and restoration of vital municipal services in North Mankato following the city's flood disaster of April 1951. . . ."

Forrest E. Byrns, hydraulic engineer with the U.S. Bureau of Reclamation, in Washington, D.C., is now serving with the Bureau's Foreign Operations administration in Pakistan as an adviser to the government of Pakistan on national water resources problems.

E. W. Gradt has been promoted from district engineer to head of the Syracuse (N. Y.) office of the American Institute of Steel Construction.

Aulis Junttila, of Helsinki, Finland, has been named second minister for Communications and Public Works in charge of housing and employment in Finland. Mr. Junttila has been employed as chief manager of Sementtiyhdistys (Cement Association) of Helsinki.

Erik Rettig was recently appointed Far Eastern representative for the Harza Engineering Co., of Chicago, Ill. Associated with the firm for several years, Mr. Rettig has been resident engineer on the Ambuklao hydroelectric project in the Philippine Islands for the past several years.

Charles D. Curran has changed his position from senior specialist in engineering and public works for the Library of Congress to that of Administrator for the Task Force on Water Resources and Power, Commission on Organization of the Executive Branch of Government, Washington, D. C.

Frank T. Drought, consulting engineer of San Antonio, Tex., was recently named 1954 president of the Texas Society of Professional Engineers.

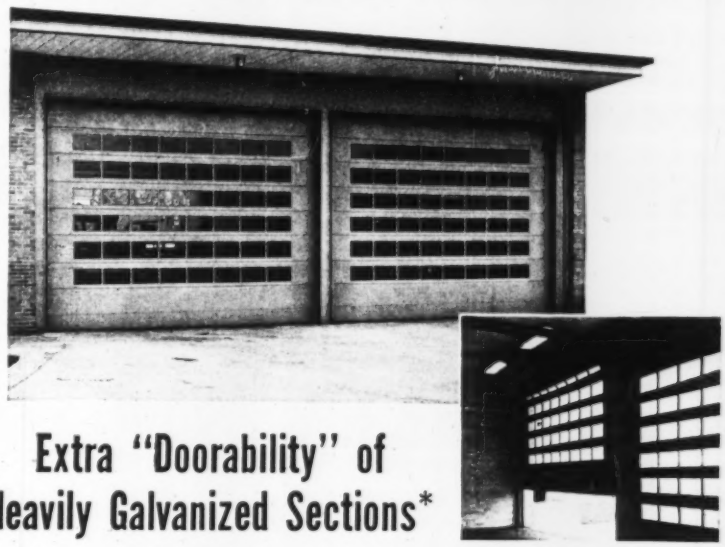
Henry T. Heald, chancellor of New York University, was named to national honorary membership in Chi Epsilon, honorary engineering fraternity, at the organization's annual meeting in New York City on October 23.

William M. Hoge, lieutenant general, commander of the U.S. Seventh Army in Germany, has been named Commander in Chief of the U.S. Army in Europe. General Hoge, who has many years of service in the Engineer Corps, was in charge of the Alcan highway in its early phases, and guided port operations to supply D-Day troops assaulting Omaha beach in the Normandy invasion in World War II.

John W. Hubler, chairman of the department of civil engineering at Washington University, has been elected president of the Missouri Society of Professional Engineers, and will take office on January 1.

(*Continued on page 98*)

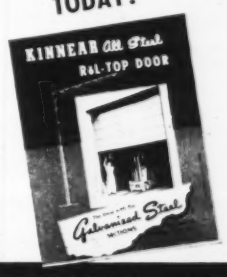
Kinnear Steel RōL-TOP Doors



Extra "Doorability" of Heavily Galvanized Sections*

Will not sag, warp, rot or split
Built to fit openings of various sizes
Easy space-saving upward action
Opens completely out of the way
Lasting resistance to fire, wind, weather
Heavy-duty torsion spring counterbalance
Provision for any number of glass panels
Easily installed in old or new buildings

WRITE FOR THIS FREE RōL-TOP BULLETIN TODAY!



In Kinnear Steel RōL-TOP Doors, you get the efficiency of smooth ball-bearing upward action . . . *plus* all-steel strength and durability . . . *plus* provision for glass panels in one or more door sections, as desired.

*To assure extra service life with minimum maintenance, the rugged steel sections are given a heavy coating of pure zinc (1.75 oz. per square foot of flat metal per ASTM standard) by the hot process. Then Kinnear's Paint Bond (a special phosphate immersion process) is added, to make sure paint will adhere *immediately and thoroughly* to the protective zinc coating.

In every detail, Kinnear Steel RōL-TOP Doors feature extra strength and ruggedness, for long, heavy-duty, low-cost performance. Sizes to fit any opening. Manual, chain, or motor operation. WRITE FOR FULL DETAILS.

KINNEAR ROLLING DOORS
Saving Ways in Doorways

Kinnear Steel RōL-TOP Doors are designed and built by the same door specialists who *originated* the door with the interlocking steel-slat curtain—famous for more than half a century as the Kinnear Steel Rolling Door.

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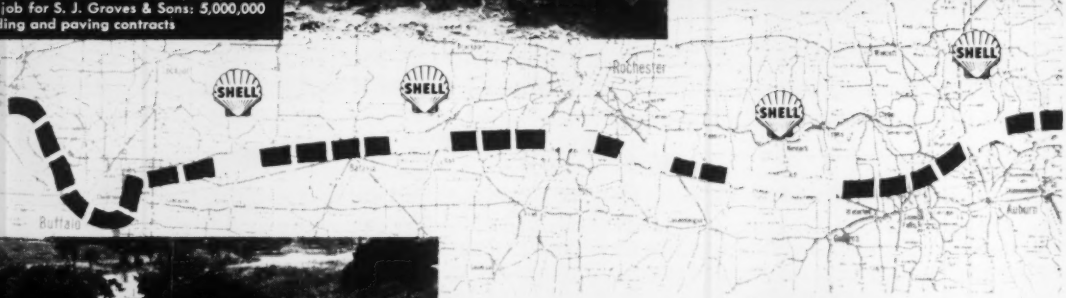
On the New York State Thruway

Shell crankcase lubricants keep heavy duty tractors on the job for S. J. Groves & Sons: 5,000,000 cu. yd. grading and paving contracts

A single Shell grease normally lubricates all grease fittings on earth moving equipment like this



Severe operation causes no motor problem with Shell Heavy Duty oil in the crankcase

Shell E. P. Gear Lubricant takes the punishment during rough going on steep grades

Arute Bros., Inc. depend upon the "stay-put" qualities of Shell's Multi-Purpose Grease for continuous heavy duty work

. . . 1 out of every 3 construction miles uses SHELL PRODUCTS *exclusively*

That's just one way of saying that Shell has been awarded contracts by companies responsible for building sections of the New York State Thruway totaling over one third of the entire mileage. And the contracts are still coming in!

Trucks, shovels, dozers, graders . . . all equipment run by gasoline or diesel engines on those long stretches of highway construction . . . benefit from the outstanding performance of Shell heavy duty lubricants.

Products that can win the unqualified preference of such responsible and efficient operators must have what it takes . . . and Shell products *have* it . . . plenty!

Most popular on the Thruway, and equally popular wherever heavy duty engines operate, Shell lubricants keep on protecting, defying wear, and keeping maintenance costs at rock bottom. Why not specify Shell for your equipment?

Thruway Map © by General Drafting Co., Inc., Convent Station, N. J.

2½ cu. yd. Shovels thrive on Shell Heavy Duty Lubricants under extremes of load conditions

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NEWS OF ENGINEERS

(*Continued from page 95*)

Karl Imhoff, consulting engineer of Essen, Germany, and internationally known sanitary engineer, has been awarded the Great Cross for Distinguished Services by the German Federal Republic, in recognition of his "services to mankind in the field of public hygiene." The award is the highest decoration of merit awarded by the German government for service to engineers and scientists.

Frank H. Dryden is retiring as assistant administrator for construction with the Veterans Administration in Washington, D. C., to enter the private consulting engineering field.

Joseph P. Lawlor, president of the General Filter Co., of Ames, Iowa, has just been elected mayor of the city of Ames. Mr. Lawlor previously served as councilman for the city.

Harry C. Jessen is managing the newly-opened branch sales office of the Sika Chemical Corp., at Salt Lake City, Utah. Mr. Jessen has been city engineer for Salt Lake City; supervising engineer of federal works for Utah, Wyoming, Colorado, and New Mexico; and district engineer for the Housing and Home Finance Agency at Salt Lake City.

John I. Parcel, vice-president of Sverdrup & Parcel, Inc., St. Louis, Mo., was honored by his friends and former students at a recent dinner on his 75th birthday at the Hotel Nicollet, Minneapolis. A group, headed by **Joseph A. Wise,** professor of civil engineering at the University of Minnesota, has been preparing a commemorative volume, and announcement of its proposed publication was made at the dinner.

Paul J. Prout, formerly a consulting engineer at Long Beach, Calif., has resumed the study of architecture at the University of Southern California and is employed by Adrian Wilson and Associate Architects, Los Angeles.

Victor M. Cone, chief engineering assistant and head of the engineering division of the Nashville District of the Corps of Engineers, retired on August 31 after 37 years in federal service. He began his career with the Department of Agriculture and joined the Corps at the Memphis District office in 1929. In 1938 he was assigned a post at the Little Rock division office and five years later was transferred to Nashville as principal engineer.

Lee W. Crandall, Fulbright Research Scholar, is now working with **Prof. F. E. Siimes,** director of the Wood Technology Laboratory at the State Institute for Technical Research in Helsinki, Finland. On leave from the civil engineering department of the University of Wisconsin, Dr. Crandall is engaged in timber design research and a study of the wood industry in Finland.

Lawrence V. Sheridan, municipal planning consultant of Indianapolis, Ind., an-

nounces the merger of his firm, Lawrence V. Sheridan & Son, with that of **Kenneth L. Schellie,** to form Metropolitan Planners, Inc., with offices at 800 Board of Trade Building, Indianapolis.

Lewis A. Stanley has left the Alaska District of the Corps of Engineers, Anchorage, to accept a position as engineer for the Oregon Klamath River Commission, with headquarters at Klamath Falls, Oreg.

John R. Swanton, of Hammond, Ind., was elected president of the Indiana Society of Professional Engineers at the annual meeting of the organization on November 7. Mr. Swanton is a partner in the firm of Consoer, Townsend & Associates, Chicago, Ill.

Stephen D. Teetor has been made an associate in charge of foundation, soil mechanics, inspection, and research, for the New York consulting firm of Seelye Stevenson Value & Knecht.

David K. Todd, who completed requirements for the Ph.D. degree in civil engineering at the University of California, Berkeley, in September, has been appointed an assistant professor in the department of civil engineering at that institution.

Charles M. Upham, consulting engineer of Washington, D. C., and consultant to Arthur D. Little, Inc., Cambridge, Mass., recently flew to Egypt to determine methods of constructing a modern highway system for that country. The work is part of the Point 4 program for the area.

Bernard A. Vallerga, since 1947 assistant professor of civil engineering at the University of California at Berkeley, was recently named managing engineer of the Asphalt Institute's Pacific Coast Division at San Francisco, replacing **Arvin S. Wellborn** who has been promoted to chief engineer.

Robert W. Van Houten, president of the Newark College of Engineering, was elected the 37th president of the Association of Urban Universities for 1953–1954, at the association's annual meeting at St. Louis, Mo.

Frederick H. Warren, who recently served as Deputy Director of the Construction and Supply Division of the Atomic Energy Commission, has announced the opening of an office at 1518 K. Street, N. W., Washington, D. C., devoted to consulting engineering in the field of atomic energy. He has been in the Engineering Division of the AEC since 1947.

Robert L. Reisinger, Jr., formerly associated with Ammann and Whitney, Milwaukee, is now in charge of operations for Soil Testing Services of Wisconsin, Inc., Milwaukee, in the territory of Wisconsin, Minnesota and upper Michigan. He succeeded **Robert Novak,** now directing the firm's work in the north central area, from the Chicago office.

Leigh M. Huggins, consulting engineer of Boise, Idaho, was recently appointed highway analyst for the Idaho State Highway Department. He is the first analyst to be named under the expanded program of the department's planning division.

(Continued on page 100)

Shoring system and beams support wall of existing structures
Bay unexcavated - to save underpinning of structure later to be demolished
Access to subway is underpinned and maintained

Project: Rebuilding Jordan Marsh, Boston Department Store, a section at a time.
Contractor: Thompson Starrett, Inc.
Architect: Perry, Shaw & Hepburn
Engineer: Maurice A. Reidy

CONTINUOUS MAT PUT IN FAST AS BIG STORE REPLACES ITSELF

This project had to be handled in separate sections, so that the store could continue doing business during construction. Section II, a 900 x 94 ft. portion of the property, is shown above with the highlights noted. It was necessary to use extreme care in the installation of the 30 ft. high system of pilot beams and horizontal sheeting to prevent movement of adjacent buildings and streets.

The drainage problem was simplified by our installation in Section I of a drainage system which had the capacity to remove the water of both sections.

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NEWS OF ENGINEERS

(Continued from page 99)

A. E. Duckwall, since 1950 chief engineer of the Coal Division of the U.S. Steel Corp., retired on October 1, after 37 years of continuous service with the company. From 1930 to 1940 he was assistant chief engineer and chief engineer of the Kentucky Division of U.S. Coal & Coke, a U.S. Steel subsidiary, and from 1940 to 1950, chief engineer for the same subsidiary at Gary, W. Va.

D. B. Gumensky has returned to the United States after three years as chief of design on Israel's water development program to open an office as a consulting engineer in Berkeley, Calif. Mr. Gumensky will specialize in hydro power, water, dam and tunnel problems. He was formerly with the Metropolitan Water District of Southern California.

E. C. Credle announces that he has joined his father, **S. M. Credle,** of Durham, N. C., in forming the Credle Engineering Co., at 204 E. Markham Ave., Durham. He was formerly an area engineer for E.I. du Pont de Nemours Co., Inc., on the Savannah River project.

B. P. Rice, until recently regional engineer on public utilities for the Public Agency Division, Office of Loans, of the Reconstruction Finance Corp., at Atlanta, Ga., has retired after 15 years in the federal service. He is now connected with the Colonial Terrace Hotel in Atlanta. At one time Mr. Rice was state sanitary engineer for South Carolina.

Samuel B. Settle, formerly consulting engineer with the firm of Samuel B. Settle & Associates, Parkersburg, W. Va., has accepted a position as development engineer with the Parkersburg Rig & Reel Co.

Solution to problem on page 53

Temporary footings designed to be part of the final foundations were sunk 40 ft below street level, through the existing basement, during the previous year. The work was on a 24-hour-a-day schedule, and was performed inside plywood partitions during store hours. These temporary foundations were completed in October and the basement was cleared for the Christmas rush.

Early in January demolition of the existing building started, and was completed early in February. Steel erection for the new 17-story building started immediately. Excavation and erection of the permanent foundations kept pace with the steel erection, and the final foundations were completed before the temporary footings became overloaded. The building was turned over to the owners on November 1 of the same year—in time for the next Christmas rush.

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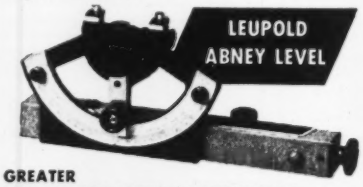

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The thousands who own Allis-Chalmers Model D's know the ability of these versatile machines to do outstanding work on both construction and maintenance jobs. Now — with extra power and added features — the Model D sets even higher performance standards in the low-cost grader field.

Dynamic New Power-Crater Engine gives the Model D reserve power to : (1) handle the same loads in higher gear or bigger loads in the same gear, (2) increase road speeds, especially where there are grades, (3) reduce need for shifting, thus lengthen clutch life, (4) give better all-round maneuverability. There's plenty of power to crowd while loading with the rear-end loader. Engine throttles down to half speed *and still does the same job* — on low-speed work.

Leaning front wheels* enable the Model D to handle new jobs . . . counteract side-draft on ditching and bank cutting.

Power circle turn* permits easy positioning of blade from operator's seat. When finishing subgrade or blacktop, for example, moldboard can be readily rotated without disturbing road surface.

These and other big-grader features — such as ground-gripping Tandem Drive, ROLL-AWAY Moldboard, Tubular Frame and Power Controls — combined with extra power make the Model D the accepted leader in the low-cost grader field. Ask your Allis-Chalmers dealer to demonstrate on your own job.

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*Optional equipment

POWER-CRATER Engine brings *truly modern* power to the Model D

This new engine boosts power while using less fuel per horsepower. It obtains high-octane performance when using regular gasoline. Only by watching a new Model D work can you fully realize what this truly modern engine adds to its performance!

Weight: 8,800 lb. (bare) • Brake Horsepower: 50
4 Speeds forward to 25.6 mph.
Reverse Speed 3.3 mph.

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Men Available

STRUCTURAL ENGINEER; J. M. ASCE; 29; married; BCE; 5 years' experience in design of bridges and heavy steel structures for dams, power plants, and refineries. Includes complete design analyses, supervising preparation of drawings, checking drawings and computations. Position need not be limited to design. Eastern states except large cities. C-906.

CIVIL ENGINEER; J. M. ASCE; 25; married; BSCE (sanitary major), Oregon State College, 1950; 3 years' experience in water control planning, coordination and basic power investigations. Desires employment with utility, municipality or contractor. C-907-5310-A-1 San Francisco.

CIVIL ENGINEER; M. ASCE; 48; BSCE; Ohio registration; 28 years' engineering construction and executive experience, mostly airports, airways, and highways. Qualified to direct surveys, design, specification, construction, research or technical writing. Location preferred, Midwest. Desires reasonable permanence of location. C-908-745-Chicago.

CIVIL OR HYDRAULIC ENGINEER; J. M. ASCE; 27; married; BSCE; 4 years' hydraulic experience with the U.S. Geological Survey, T. V. A., and the Corps of Engineers. One years' maintenance and construction with the U.S. Air Force, honorably discharged. Desires position with engineering firm. Location preferred, South. C-909.

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ENGINEER; foreign heavy engineering-construction experience acquired in 25 years as executive, one half abroad, including negotiations with governments, banks, etc., and operation of contracts and all business pertaining thereto. M. ASCE. Available in auxiliary capacity without changes in existing organization. C-910.

CIVIL ENGINEER; J. M. ASCE; 26; married; MSCE; licensed in California; 2 years' experience in hydraulic engineering (water supply, sewerage and dams); 2 years' experience in bridge engineering (foundation and superstructure design and checking). Fair knowledge of Spanish. Interested in foreign work for contractor on heavy construction. C-911.

RAILWAY ENGINEER; A. M. ASCE; 41; married, fluent Spanish; 22 years' field and office experience in railway engineering, maintenance and construction; 15 months' with consultants as chief of surveys for hydraulic development projects. Desires permanent position with railway, consultant or contractor. Location, Latin America preferred. C-912.

CHARTERED ENGINEER; M. ASCE, ASME and other foreign engineering societies. Indian University. On editorial board of several Indian and foreign technical journals; 12 years' experience in professional practice. Vast experience in technical journalism. Available as representative of civil engineering firms or technical correspondent of engineering journals in India. Specialist, light metal structures. Presently residing in India. C-913.

CIVIL ENGINEER; J. M. ASCE; 24; single; BSCE, 1951; 2½ years' diversified experience in structural design, drafting, and surveying. Available February 1954, upon release from active duty with the U.S. Army. Desires responsible work in design and/or construction. Location preferred, Northeast. C-914.

Positions Available

SALES ENGINEERS, 24-30, engineering degree desirable; previous sales experience not necessary. Established national concern selling prefabricated metal products to engineering and construction markets. Complete training program; car furnished; salary and bonus. Territories—Albany, N.Y., and Pittsburgh, Pa. Y-8588.

HIGHWAY AND BRIDGE ENGINEERS, DESIGNERS AND DRAFTSMEN for company engaged in large highway and bridge projects. Must be experienced in expressway design. Salaries open. Submit complete resume of education, experience, salary expected and availability. Location, Maryland. Y-8969.

SANITARY ENGINEER with at least 4 years' experience covering design of water works and sewage treatment plants. Salary, $5,000-$7,000 a year. Location, New York, N.Y. Y-9113.

INSTRUCTOR IN CIVIL ENGINEERING, to teach general mechanics courses and possibly hydrology. Master's degree required. Salary, $4,000-$4,500 for 9 month term. Location, Rocky Mountain region. Y-9194.

MANAGING EDITOR, under 30, civil engineering degree, for civil engineering publication. Will be responsible for conceiving, developing and programming as well as editing. Will carry out a college promotion program with 140 civil engineering colleges, including exhibits and teaching aids such as manuals, handbooks and information for speeches. Location, Midwest. Y-9218.

TECHNICAL FIELD SUPERVISOR with construction background and engineering training in the building field, to engage in technical sales promotional work on building products salesmen and distributors. Salary open. Location, Cleveland, Ohio. Y-9219.

RESIDENT ENGINEER, preferably with PE license and with at least 10 years' highway and bridge experience for turnpike project. Salary, $9,000 a year. Location, Ohio. Y-9268.

DEAN OF ENGINEERING COLLEGE giving courses in electrical, mechanical, civil and chemical engineering. Should have some interest in research. Salary, $10,000-$12,000 a year. Location, Ohio. Y-9281.

CIVIL ENGINEER, graduate, with 5-10 years' general surveying experience with heavy exposure to property surveys. Company engaged in photogrammetric engineering and cadastral mapping services. Writing full particulars including education, availability, experience, career objectives and salary requirements. Location, northeastern U.S. Y-9292.

CONSTRUCTION COST ESTIMATOR, age 30, with some tax and accounting background for preparation and review of property tax returns and payment reviews, and also to interpret property tax laws, court decisions and administrative rulings. Some traveling. Salary, $5,000 a year. Location, New York, N.Y. Y-9298.

INSTRUCTORS TO FULL PROFESSORS with MS, Ph.D. or BS degrees. Civil Engineer with structural engineering design experience. Salary, $5,900 for nine months, or $7,375 for nine months plus the summer session. Positions start September 1954. Location, South. Y-9305 (*b*).

INSTRUCTOR OR ASSISTANT PROFESSOR in civil engineering, preferably with MS degree and practical or teaching experience; major interest in fluid mechanics. Position starts fall 1954. Location, Indiana. Y-9307.

CONSTRUCTION SUPERINTENDENT, 35-40, civil graduate, with general building experience and considerable reinforced concrete housing construction for permanent position with general contractor. Salary, $8,000-$10,000 plus bonus. Location, western New York State. Y-9330.

CONSTRUCTION MANAGER, graduate civil engineer with 5 to 10 years' construction experience, to handle an $800,000 volume of industrial, school and commercial construction. Location, Midwest. Y-9332.

INSTRUCTOR OR ASSISTANT PROFESSOR in sanitary engineering; MS desired, but not required; to teach undergraduate sanitary engineering courses and to do research in sanitary industrial fields; eleven months' service. Position starts February 1, 1954. Salary commensurate with training and experience. Location, Pacific Northwest. Y-9336.

ASSISTANT CITY PLANNER with college training in city planning, engineering or both. Several years' experience in zoning, mapping and land subdivision. Salary, $5,650 a year with 4 annual increments of $150 a year. Location, upstate New York. Y-9337.

PROFESSOR in civil engineering. Duties involve the teaching of such courses as surveying, structural design and sanitary engineering. Position open to recent graduates. Salary and academic rank open depending on degree and experience. Position starts January 15, 1954. Location., Kansas. Y-9339.

DESIGNER, civil engineering, with experience in urban expressway highway design including structures. Should have 2 years' city planning experience. Must be free to travel. Location St. Louis, Mo. C-1376.

SALESMAN, civil or construction engineering training; about 25, with at least 3 years' experience in construction and sales. Knowledge of masonry construction. To sell services to architectural engineers, contractors and owners on new and existing buildings on building masonry restoration and seal finishes. Territories open, Chicago, Detroit and greater New York for waterproof contractors. Salary $6,500 a year drawing against commission. C-1386.

TECHNICAL SERVICE MANAGER, 38-42, with knowledge of lightweight aggregates. Will work as liaison man with research department to develop sales and technical data for the field. Will work with sales and research in developing new uses for aggregates. For a manufacturer of aggregates. Salary open. Location, Chicago, Ill. C-1403.

VILLAGE ENGINEER AND DIRECTOR OF PUBLIC WORKS. Civil graduate, to 50, with at least 5 years' experience in municipal public works. Duties will include administrative and professional engineering of public works for a municipality. Salary, $7,200-$7,800 a year. Location, northwest Chicago suburb. C-1406.

New Publications

Licensing Information. Detailed instructions for completing all application forms for the Professional Engineer's License Examination in the State of New York have been compiled by John D. Constance, P.E., with the approval of the New York State Board of Examiners. Single copies of the compilation, reprinted from *Power Engineering*, are available without charge from Mr. Constance at 625 Hudson Terrace, Cliffside Park, N. J.

Soil Temperature. Issuance of a bulletin consisting of five papers on soil temperature and ground freezing, given at the 32nd annual meeting of the Highway Research Board in January 1953, is announced by the Board. Four of the papers present data from investigation of the freezing and thawing of soils, and the fifth discusses research needs relative to frost action in soil. Identified as Bulletin 71, the publication may be obtained from the Highway Research Board, 2101 Constitution Avenue, Washington, D. C., at $1.80 a copy.

Hydraulic Research. Studies of the hydraulics of closed conduit spillways—prepared by the U. S. Soil Conservation Service in cooperation with the Minnesota Agricultural Experiment Station and the St. Anthony Falls Hydraulic Laboratory—have been made available by the Laboratory as Technical Paper No. 12, Series B. The author is Fred W. Blaisdell, A.M. ASCE, project supervisor for the SCS. Inquiries should be addressed to the St. Anthony Falls Hydraulic Laboratory, University of Minnesota, Minneapolis, Minn.

Foundation Engineering. The advantages, disadvantages, and limitations of direct shear testing of soils are outlined in a 96-page symposium issued by the American Society for Testing Materials. The paper-bound publication, consisting o fa series of six papers sponsored by the organization's Committee D-18 on Soils for Engineering Purposes, sells for $2, upon application to the ASTM, 1916 Race Street, Philadelphia 3, Pa.

Sanitary Engineering. An investigation of the performance of six small septic tanks—conducted by the University of Illinois Engineering Experiment Station in cooperation with the Armco Steel Corp.—is reported in Bulletin Series No. 409 recently released by the Station. The authors are E. Robert Baumann, research associate in civil engineering, and Harold E. Babbitt, professor of sanitary engineering. The price is 60 cents, and inquiries should be addressed to the University of Illinois Engineering Experiment Station, Urbana, Ill.

Prestressed Concrete. Structural behavior of a prestressed concrete pedestrian bridge over the Arroyo Seco in Los Angeles—studied as a joint project of the California Division of Highways and the Institute of Transportation and Traffic Engineering of the University of California—is described by T. Y. Lin and Jack Sylvester in the Institute's recently released Research Report No. 12. Another of the Institute's new publications (Research Report No. 13, by T. Y. Lin, R. Horonjeff, R. W. Cough, and C. F. Scheffey) details a joint investigation of stresses in the San Leandro Creek Bridge. Cooperating groups on the latter study were the Division of Highways, the Institute of Transportation and Traffic Engineering, and the U. S. Bureau of Public Roads. Inquiries on both should be addressed to the Institute of Transportation and Traffic Engineering, University of California, Berkeley, Calif.

Better Highway Contest. The three top entries in the recent General Motors Better Highways Awards contest are reprinted in full by the company in a recent General Motors booklet entitled *How to Plan and Pay for Better Highways*. Twelve other leading entries are also summarized in the booklet, which may be obtained from the Department of Public Relations, General Motors, Detroit 2, Mich.

Building Code Standards. The building code standards set up by 21 leading technical associations and material testing organizations sponsoring the standards generally in use throughout the industry are embodied in *Uniform Building Code Standards*, Vol. III, a publication of the Pacific Coast Building Officials Conference. Copies of the volume, which is said to be necessary to efficient use and understanding of the Building Code, may be obtained from the Building Code Publishing Co., P.O. Box 3217 Terminal Annex, Los Angeles 54, Calif. It is priced at $7.50, plus a handling and postage charge of 25 cents a copy. For California purchasers there is a sales tax of 3 percent (3½ percent in Los Angeles).

Soil Mechanics. Intensive research work carried out by ASTM Committee D-18 on Soils for Engineering Purposes is reported by the American Society for Testing Materials in a *Symposium on the Use of Radioisotopes in Soil Mechanics*. The three papers making up the 40-page volume are "Radioisotopes and Nuclear Reactions Applied to Soil Mechanics Problems"; "Use of Radioactive Material to Measure Soil Moisture and Density"; and "Determining Soil Moisture and Density by Nuclear Radiations." Copies of the symposium may be obtained from the headquarters of the ASTM, 1916 Race Street, Philadelphia 3, Pa., at $1.25 each.

Origin-Destination Surveys. The results of a comparison analysis of the data collected by a home-interview origin-destination survey with the data from a postcard study are set forth by James H. Kell in a 158-page bulletin of the Purdue University Engineering Experiment Station. Requests for copies—entitled *Comparison of Two Methods of Internal Origin-Destination Surveys* and priced at $2 a copy—should be sent to the Director, Engineering Experiment Station, Purdue University, Lafayette, Ind. Remittances are payable to Purdue University.

Waterways Experiment Station. Several technical memoranda reporting model and other investigations conducted by the Waterways Experiment Station are available from the Office of the Director of the Station at Vicksburg, Miss. The list includes No. 2-358, consisting of studies of the upstream emergency dam for Cheatham Lock on the Cumberland River in Tennessee, made for the Nashville District of the Corps of Engineers; No. 2-364, which reports a study of finite boundary roughness in rectangular flumes; and No. 6-359, which describes tests of blends of portland cement with masonry cement. They sell for $1 each.

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Positions Announced

City of Philadelphia. The position of Sanitarian I with a salary ranging from $4,108 to $5,160 is now available in the Philadelphia civil service. The requirements include four years of college with an appropriate major or four years of equivalent experience. Application blanks may be obtained from the Personnel Department, Room 127, City Hall, Philadelphia 7, Pa., and must be filed with the Division of Recruitment and Examining, Room 127, City Hall, before midnight, December 21.

U. S. Civil Service. An examination has been announced by the United States Civil Service Commission for Engineer (various options) for filling positions paying from $3,410 to $10,800 a year in various federal agencies in Washington, D. C., and vicinity. To qualify for these positions, applicants must show appropriate education or experience in the field of work for which application is made; no written exam will be given. Full details concerning the requirements to be met are given in Civil Service Examination Announcement No. 383. Information on examinations may be obtained from most post offices or from the U. S. Civil Service Commission, Washington 25, D. C.

RECENT BOOKS

Modellversuche Uber Den Einfluss Der Torsionssteifigkeit Bei Einer Plattenbalkenbrucke

An analysis by Gerhard Marten of the results of model tests to determine the influence of torsional rigidity in a rigid-frame bridge. The details are from tests performed on a 3-span reinforced-concrete rigid-frame bridge model. (Deutscher Ausschuss für Stahlbeton, No. 111. Wilhelm Ernst & Sohn, Berlin, 1952. 26 pp., DM 5.)

Symposium on Exchange Phenomena in Soils

Five articles are included in Special Technical Publication No. 142 which deal with related aspects of this field of soil physico-chemistry. They deal with basic phenomena leading to methods by which soils are altered to achieve adequate engineering performance even under adverse circumstances. Both generalities and specific data are provided. (American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., 1953. 74 pp. $1.75.)

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Eighth of a series of research reports on plate buckling, this publication by F. Stussi, C. F. Kollbrunner and H. Wanzenried, covers the buckling of rectangular plates under pressure, bending, and combined pressure with bending. Results are given of a mathematical investigation to determine the critical buckling value under various stress conditions and types of support. (Mitteilungen aus dem Institut für Baustatik an der E.T.H. No. 26. Verlag Leemann, Zürich, 1953. 35 pp., Sw. Frs. 6.25.)

ASTM Standards on Bituminous Materials for Highway Construction, Waterproofing, and Roofing

The new edition of this compilation brings together in compact, readily usable form the 105 standard and tentative specifications, test methods, definitions of terms, and recommended practices dealing with the materials indicated, including impregnated fabrics. There are also recommended practices for accelerated weathering tests, bituminous mixing plant inspection, and other related topics. (American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., 1953. 420 pp., $3.50.)

Beton-Kalender, 1953

The forty-second edition of a comprehensive two-volume handbook of concrete and concrete construction. Chapters have been added on elastic plates, staircase construction, and Belgian and Brazilian specifications for concrete and steel. Sections on concrete and mortars have been completely revised, and other sections revised to conform with the latest specifications. DIN specifications are cited throughout and frequently reproduced. (Wilhelm Ernst & Sohn, Berlin, 1953. 760 pp.; 440 pp., DM 16.00/2 parts.)

Contribution à la Théorie des Ondes Liquides de Gravité en Profondeur Variable

A detailed mathematical analysis of the characteristics and behavior of surface waves in water of varying depth, such as on a sloping beach or in a channel. Both two- and three-dimensional approaches to the problem are utilized. The author is Maurice Roseau. (France, Ministère de l'Air Publications Scientifiques et Techniques, no. 275, Paris, 1952. 89 pp., Ffrs. 1300.)

(*Continued on page 106*)

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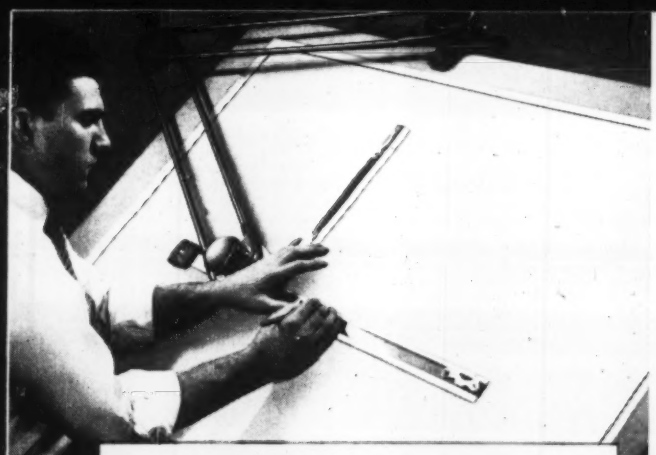

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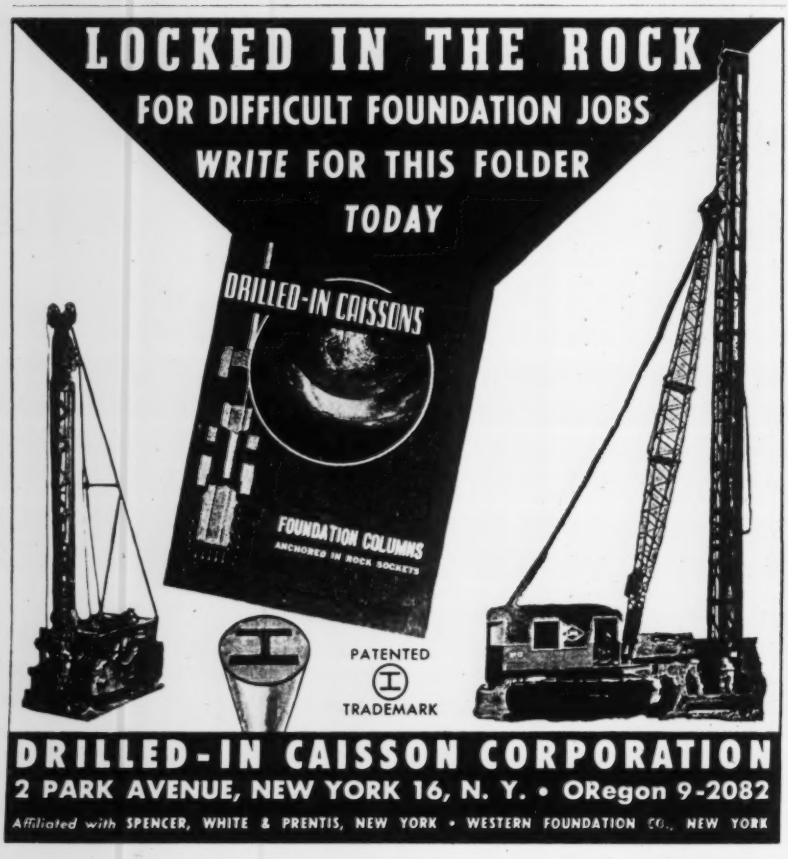
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Recent Books

(*Continued from page 104*)

Fundamentals of Structural Analysis

An elementary textbook and practical reference volume on the fundamental principles involved in the stress analysis of statically determinate engineering structures by A. A. Jakkula and Henson K. Stephenson. Topics covered include external and internal equilibrium, loads, roof trusses, wind loads, cables and arches, mill bents, beams and girders, bridge trusses, and influence lines for various reactions. The work of a structural engineer is briefly outlined. (D. Van Nostrand Company, Inc., 250 Fourth Ave., New York 3, N. Y., 1953. 288 pp., $4.50.)

Symposium on Continuous Analysis of Industrial Water and Industrial Waste Water

The five papers included in ASTM's Special Technical Publication, No. 130 deal with the following: Automatic sampling of industrial water, measurement of pH, electrical conductivity, etc., continuous recording of chlorine residuals, measurement of color, turbidity, hardness, and silica; and the continuous measurement of dissolved gases. (American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., 1953. 54 pp., $1.50.)

Tables of Normal Probability Functions

A companion volume to the previously published tables of the error function and its derivative, this book—Applied Mathematics Series, No. 23—presents a tabulation of the functions $Q(x)$ and $P(x)$ to 15 decimal places at intervals of 0.0001 in the range of x between 0 and 1, and of 0.001 for x between 1 and 7.8. An explanatory introduction and a bibliography are included. (National Bureau of Standards. Available from Superintendent of Documents, G. P. O., Washington 25, D.C., reissue of Mathematical Table 14, with corrections, 1953. 344 pp., $2.75.)

Famous Subways and Tunnels of the World

Tunnels have challenged the ingenuity of man since before the beginning of recorded history. In an easily readable 100-page illustrated book suited to readers both young and old, Edward E. White, M. ASCE, and his wife, Muriel, tell the story of man's daring and dangerous struggles to tunnel through mountains, under rivers, and along busy streets. Edward White has been working with tunnels all his life. He was born on the Catskill Aqueduct job where his father, the late Lazarus White, M. ASCE, had charge of a part of the project. (Random House, Inc., 457 Madison Ave., New York, N.Y., 1953. 100 pp., $1.75.)

Famous Bridges of the World

Written by a renowned civil engineer who has designed and built bridges all over the world, Dr. D. B. Steinman, M. ASCE, this 100-page book traces the development of the bridges from the first tree felled across a stream by legendary man to the great steel spans of today. It is directed at young readers particularly, but is good reading for oldsters too. The author recently completed reconstruction of the world famous Brooklyn Bridge built by the Roeblings, 1869–1883. (Random House, Inc., 457 Madison Ave., New York, N.Y., 1953. 100 pp., $1.75.)

Library Services

Engineering Societies Library books may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 33 West 39th Street, New York 18, N.Y.

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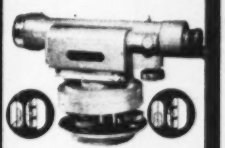

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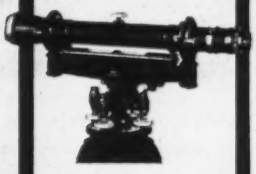

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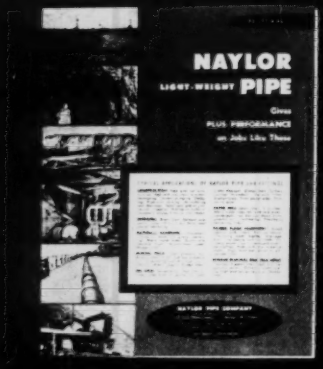
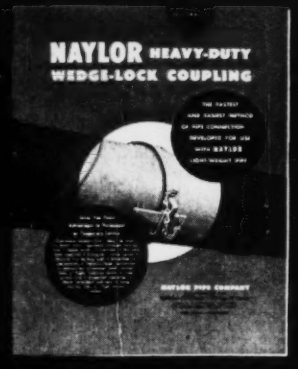
SHORT COURSE ON PIPING

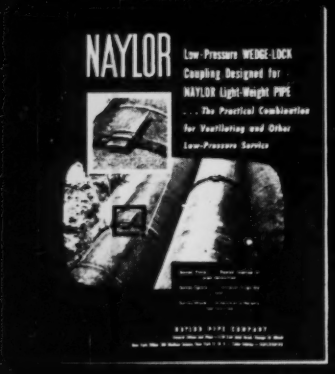
These four bulletins make up a handy reference library on light-weight pipe, connections and fittings and their applications in your field.



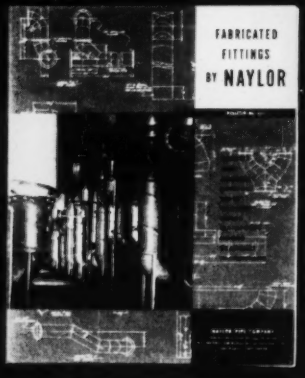
Bulletin No. 507 covers the applications and specifications of Naylor light-weight pipe and fittings.



Bulletin No. 513 presents data on Naylor heavy-duty Wedge-Lock couplings for permanent or temporary service.



Bulletin No. 514 offers information on Naylor low-pressure Wedge-Lock couplings for vent pipe.



Bulletin No. 525 deals with Naylor fabricated fittings for both standard and special requirements.

Copies of these bulletins are available on request.

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Non-ASCE Meetings

American Institute of Chemical Engineers. Headquarters for the annual meeting of the American Institute of Chemical Engineers will be the Jefferson Hotel, St. Louis, Mo., December 13–16.

American Institute of Electrical Engineers. The winter general meeting of the AIEE will take place at the Statler Hotel, New York City, January 18–22.

American Road Builders' Association. The 1954 annual meeting of the American Road Builders' Association will be held at the Chalfonte-Haddon Hall Hotel, Atlantic City, N. J., January 5–7.

Associated Equipment Distributors. The 35th annual meeting of the Associated Equipment Distributors is scheduled for the Waldorf-Astoria Hotel in New York, N. Y., January 31–February 4.

Australian and New Zealand Association for the Advancement of Science. The 30th meeting of the Australian and New Zealand Association for the Advancement of Science will be held in Canberra, Australia, during the week of January 13th.

Canadian Conference on Prestressed Concrete. Sponsor of the Canadian Conference on Prestressed Concrete, to be held at the Hart House Theatre at the University of Toronto, January 28 and 29, is the Extension Department of the University, with Prof. C. F. Morrison of the department of civil engineering acting as chairman.

Chamber of Commerce of the United States. The Chamber of Commerce is sponsoring a two-day Conference on Highway Financing in Washington, D.C., December 10 and 11.

Chi Epsilon. A meeting of the New York Alumni Chapter will be held in the Engineering Societies Building, Room 1101, January 6, at 7:30 p.m. It will be preceded by an informal dinner in the New York Times Dining Room 11th floor, 229 West 43rd St., at 6 p.m.

Highway Research Board. The Highway Research Board will hold its 33rd annual meeting in the building of the National Academy of Sciences and the National Research Council, Washington, D. C., January 12–15.

International Union of Testing and Research Laboratories for Materials and Structures. An international symposium on non-destructive testing of concrete will be conducted by the International Union of Testing and Research Laboratories for Materials and Structures, at the Laboratoires du Bâtiment et des Travaux Publics, 12, Rue Brancion, Paris, January 11–17.

Applications for Admission to ASCE, October 24–November 7

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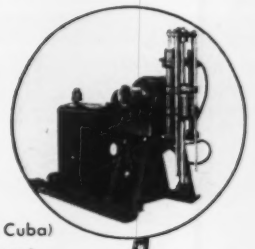

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Model L-2

profit. Features of the Model L-2 and E-2 include an all-steel, full vision cab with safety glass with 360 deg vision, more room, greater comfort and controlled ventilation. Clutches are of "roll in", self-energizing, reversible shoe type. All five clutches are interchangeable. Brakes feature increased leverage, large brake pedals and automotive type brake pedal action, giving the operator positive, effortless braking power. The new design, oil tight pans which encase all engine, jack shaft and main hoist drive gears are an important new feature. An inspection plate is so arranged that the motor pinion can be checked for alignment, or removed and replaced without removing or disturbing gear pans. Models L-2 and E-2 are equipped with a new foolproof and positive over-center house lock control, designed for greater ease of handling and conveniently located for the operator. On Models L-2 and E-2 a new rugged setback gantry of bridge type, all welded construction gives the operator greater ease in crane work, and more vision. Floor frames are of all welded 6 in. H Beam "boxed in" construction on Model L-2, and heavier 6 in. H Beam construction on Model E-2, which gives unusual strength and rigidity to withstand shock impact and hold all machinery in positive, exact alignment. Model L-2 has 2000 lb, single piece "contour type" solid counterweight as standard equipment, with 3000 lbs optional. Model E-2 1000 lb single piece solid "contour type" counterweight for special crane work is optional at extra cost. New, fully machined side frames of increased strength and advanced design, with new type diagonal bracing, assure permanent alignment of drum shafts and gears. **Quick-Way Truck Shovel Company, CE 12-110, 4002 Josephine St., Denver 2, Colo.**

Power Wheelbarrow

A NUMBER OF NEW safety and performance features now are incorporated in every Moto-Bug rolling off the assembly lines. The Moto-Bug is Kwik-Mix's popular power wheelbarrow which can be easily converted to flat bed truck or fork lift. First on the list of safety features is the "dead man" internal expanding brake system which instantly stops all machine movement when the operator's foot is off the treadle. This automatic protection feature affords extra protection against the possibility of operator carelessness or unforeseen accident. The brakes are adjustable. On the Fork Lift version, soft core rubber tires for all wheels add to the driver's comfort while eliminating the possibility of punctures and blowouts. They are optional for use on other Moto-Bug types. More efficient transmission of power from the six hp gasoline engine to the drive wheels is furnished by a cog-type V-belt of rayon cord construction. The cog design reduces belt stretch and slippage. These

Moto-Bug

V-belts are now standard on all versions. Inspection of the V-belt and other engine parts has been simplified by building a good-sized inspection door into the front panel of the cowl. Rear of engine is open so the power plant can be inspected from both sides. Another feature is a vertical clutch control lever with neutral, forward, and reverse positions. It is easily at hand for the operator and readily controls forward and reverse motion. The Moto-Bug retains all the easy-handling features which have brought it wide acceptance in the construction, manufacturing, and materials handling industries. These include narrow width of 33 in., short turning radius of 61 in., tricycle balance and large capacity on a small operating surface. **Kwik-Mix Company, Sales Office, CE 12-110, 3029 W. Concordia Ave., Milwaukee 16, Wis.**

Hydraulic Torque-Converter

PERFORMANCE OF THE MODEL HM Payloader tractor-shovel has been considerably improved by the addition of a hydraulic torque converter. This improvement is incorporated in the gas and diesel-engine models, as well as in the TM Payloader tractor, developed for heavy duty switching and towing operations. This converter is a 3-element-type which multiplies the torque output of the engine in direct proportion to the load requirements. In conjunction with the four-

HM Payloader

speed, full reversing transmission, it provides a much smoother tractor-shovel drive than has previously been available. The torque-converter, by greatly reducing the amount of clutching and gear-shifting needed, also materially reduces the amount of effort and concentration previously required of the driver. This drive acts as a cushion for the entire power train, thus protecting these components against load shocks, reducing maintenance and prolonging the life of the unit. Many users have field-tested these new models and have reported most favorably concerning the operation and advantages of the torque-converter. **The Frank G. Hough Co., CE 12-110, 938 Seventh St., Libertyville, Ill.**

Portable Compressor

A 600 CFM DIESEL-POWERED portable compressor is announced. Known as the Davey Super Chief 600, the unit is available in both skid and 4-wheel trailer mounting styles. It is the largest capacity unit produced by Davey whose line includes portable units of 60 to 600 cfm sizes. The Super Chief 600 has 4 low pressure cylinders with 8 in. bore and 4 in. stroke, and 2 high pressure cylinders with 6 $\frac{5}{8}$ in. bore and 4 in. stroke. Standard features include automatic compressor-engine controls; individually-finned, separately-replaceable cylinders; full force feed lubrication; cast aluminum crankcases; Multi-Port valves; automotive type steering; full spring suspension and double, built-in, full length tool boxes. The 4-wheel trailer is 150 in. long, 75 in. wide and 95 in. high. **Davey Compressor Co., CE 12-110, Kent, Ohio.**

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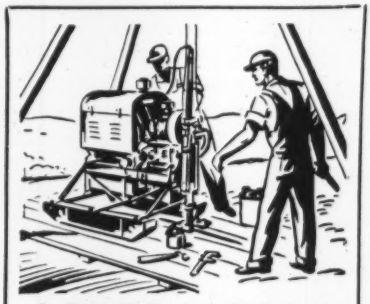

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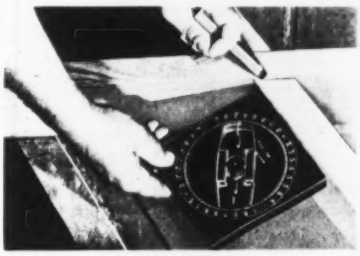
Equipment, Materials & Methods (Continued)

Ripper

THE KRITZER REVERSIBLE RIPPER offers operators a real money saving opportunity in addition to doing an outstanding job of ripping in most type formations including sandstone, decomposed granite, and hard pan. The ripper mounts directly on the tractor and is adjustable for digging depth between 8 in. and 16 in. It is set to operate automatically while the tractor is either in forward or reverse motion. For instance the units in the illustration are set to operate when the tractor is backing up. When the tractor goes forward, the ripper tooth simply drags over the ground. For operating while the tractor is going forward, the tooth is turned around so that it is pointing forward. A standard ripper tooth is used and may be installed for either side or draw bar mounting. The ripper is easily portable from tractor to tractor and job to job. **Kritzer Equipment Co., Inc., CE 12-111, 3843 West Slauson Ave., Los Angeles 43, Calif.**

Precision-Made Instrument

A PEECISION-MADE instrument that knows all the angles, the Krollometer, has been designed to save time and money and to be a worthwhile addition to equipment of home workshop owners, surveyors, construction engineers and concrete workers. Guess work is completely eliminated with the Krollometer. The movable dial face shows all the angles in degrees on the one side while the reverse side translates the degrees to inches per ft drop, carpenter square measurements and percentages of grade. It is a time saver for figuring roof framing, leveling floors and foundations.



Krollometer

The degree meter is also of value for surveying rough ground, sloping banks, ditches and grading roads. Cutting of shims to exact size each time is made possible with the Krollometer. The compact, plastic instrument is 6 in. square by $\frac{3}{4}$ in. thick and it can be easily carried in the pocket. It is a light, unbreakable unit with easily-read embossed white numerals. The styrene meter has two built-in spirit level units in the dial. Any angle can be set on the meter and work done directly from it without additional figuring. **Christensen and Kroll, CE 12-111, P. O. Box 284, McMinnville, Ore.**

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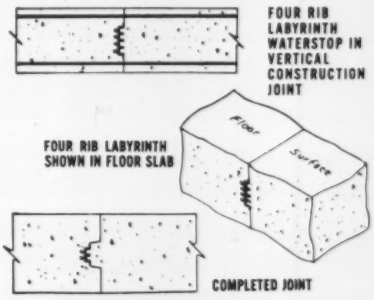

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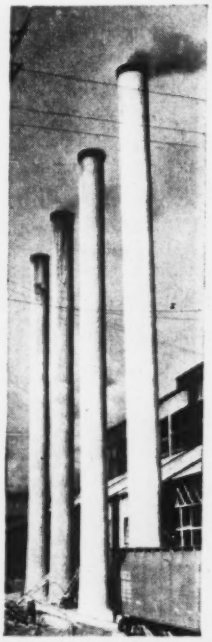
Many instances of repair, remodeling and new construction with "GUNITE" are described and pictured in Bulletin B2400. A request on your letterhead will bring your free copy by return mail.



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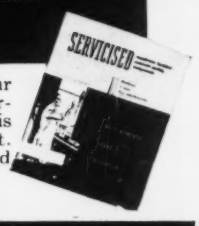

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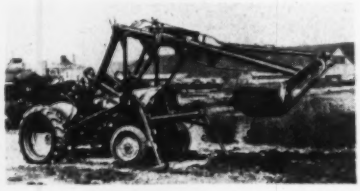
Equipment, Materials & Methods (Continued)

Trencher

A TRENCHING and ditching machine, selling for 30 percent less than any other trenching equipment on the market, is now being manufactured. Designated the Wagner Model WT swing trencher, the new completely hydraulic unit was under development for three years. Its revolutionary design makes it the only front-mounted unit on the market and is so constructed that the unit can be converted to a heavy duty loader by the addition of a standard loader dipperstick assembly. The highly maneuverable boom of the trencher has a lateral swing of more than 30 deg to the right or the left of the trench it is digging and a maximum dump height sufficient to load trucks. It is powered by the Independent Wagner Hydraulic System and is designed to handle a wide range of bucket sizes and types adding to the unit's versatility. A labor, time and space saver, the WT swing trencher is equally effective for trenching, ditching, and grave digging. The varied uses of this completely different tool include tree planting, installation of septic tanks, pipe laying, and underground electric wiring. Farmers and ranchers will also find it invaluable for digging and cleaning irrigation ditches, and tile drain ditching. **Wagner Iron Works, CE 12-112, Milwaukee, Wis.**



Model WT

Spreader

THE 1954 MODEL fully equipped motor-driven Model E HI-WAY spreader has just been introduced. Redesigned from previous models, with emphasis on sturdier construction, and on increased ease and efficiency of operation, the truck-mounted sand, salt, and cinder spreader, widely used for seal-coat work, dust control, road stabilization work and ice control, spreads sand, aggregate, calcium chloride, cinders, salt and pea gravel. A completely self contained unit, it can be mounted or dismounted from the truck frame in one or two hours, easily freeing the truck for other uses. **Highway Equipment Company, Inc., CE 12-112, Cedar Rapids, Iowa**

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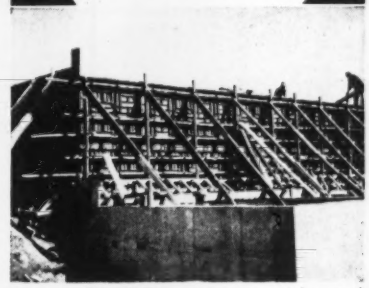

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Equipment, Materials & Methods (Continued)

Mixing & Elevating Machine

CONCRETE GUNNING contractors will be interested in a new, long needed combination proportioning, mixing and elevating machine called the Mix-Elvator. This machine is a portable, self-contained unit that is ready to operate when located at the material stockpile. An outstanding feature of the new Mix-Elvator is the readily adjustable ratio control that permits an accurate mixing range from 1:3 to 1:8. To insure continuous operation under all conditions for all types of concrete gunning equipment, the Mix-Elvator engine speed can be adjusted to give a mixing and elevating capacity from

Mix-Elvator

2½ to 8 cu yds per hr. The operator can recharge the machine as needed by means of the gate valve in the overhead hopper chute. A complete screening arrangement and a single clutch control permit material or aggregate to be handled only once during the complete operation and allow one laborer to handle the entire operation alone when the stockpile is conveniently located. **Air Placement Equipment Co., CE 12-113, 1009 West 24th St., Kansas City, Mo.**

Abrasive Blades

ABRASIVE BLADES that cut masonry materials with speeds approaching those of Diamond blades have now been perfected. Abrasive blades will slice through a 2 in. by 5 in. Natco Furing tile in only 11 sec., through first quality dry press fire brick in 5 sec., face brick in 8 sec., concrete block in 17 sec. Other features include: protective blade blotters that lessen the possibility of fracturing from over-tightening the blade collar; steel blade centers that guard the saw shaft and strengthen the blade. **Clipper Manufacturing Company, CE 12-113, Suite 813, 2800 Warwick, Kansas City 8, Mo.**

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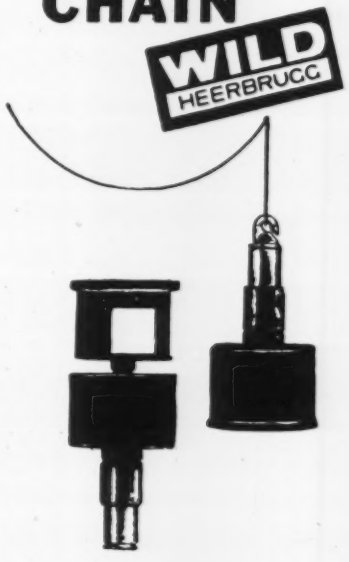

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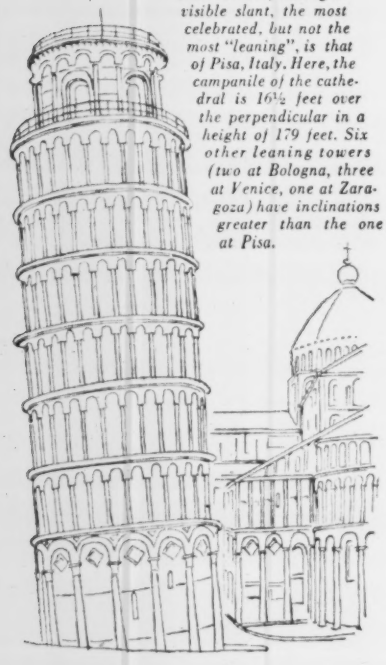
An interesting slant on Pisa!

Of the many towers which are out of the true vertical, having a visible slant, the most celebrated, but not the most "leaning", is that of Pisa, Italy. Here, the campanile of the cathedral is 16½ feet over the perpendicular in a height of 179 feet. Six other leaning towers (two at Bologna, three at Venice, one at Zaragoza) have inclinations greater than the one at Pisa.



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Equipment, Materials & Methods (Continued)

Snow Plow

THE SERIES "A" Sno-Flyr rotary snow plow is the newest member of the world's most complete line of snow removal equipment. Rugged like the famous big highway Sno-Flyr, the Series "A" type mounts on the front-end hydraulic loader of the industrial wheel-type tractor. It utilizes the same pins and connections used to attach the loader bucket. No extra braces or drilling are required. Snow removal capacity is 3 to 4 tons per minute in average snow conditions. The plow is particularly well suited for snow removal work around plant yards, storage areas, sidewalks, airports, streets, etc. Any job too big for sidewalk units and too small for the big truck units is just right for the Bros Rotary. Bucket tilting device provides positive operating control on plow and engine at different elevations. In this way, the unit can be raised to the top of high drifts, to chew them down, layer by layer. A special loading chute allows truck loading on either side of plow. It's rotating feature permits "spot" casting of snow in confined areas. Casting chute can be rotated through arc of 180 deg. A special capping device can be added to control height of ejected snow stream. **Wm. Bros Boiler and Mfg. Company, CE 12-114, 1057 10th Ave. S. E., Minneapolis 14, Minn.**

Conveyor

A PNEUMATIC CONVEYOR called the Vacu-Veyor has been introduced. Only one man is needed to operate it. Simple, fully automatic operation eliminates costly bucket and shovel methods. The pneumatic, vacuum action is continuous until the supply of material is exhausted. Vacu-Veyor conveys up to 40,000 lbs per hr, offering fast, efficient removal of all materials. It provides a method of quickly transferring materials from railroad cars, trucks or ships to vats, hoppers or storage. It will convey up to 150 ft vertically and 200 ft horizontally. Flexible hoses permit reaching around corners and other obstacles. With the completely portable Vacu-Veyor, the unloader unit may be easily moved on casters or truck trailer to any location for direct unloading. It is also the ideal system for fixed installations, being able to convey over long distances and to various levels as well as around obstacles or corners with ease. The compact units are powered with electricity or gasoline or diesel engines. Contamination cannot enter the enclosed lines or unloader unit, and silicosis and respiratory disorders are eliminated. Vacu-Veyor requires no masks or breather tubes, even in enclosed spaces, because the powerful vacuum draws fresh air into the area to replace expended air and materials. The dust collector unit gathers dust and impurities, and releases clean air into the atmosphere. Complete safety from harmful gases is provided when handling toxic materials. **Vacu-Blast Co., Inc., CE 12-114, P.O. Box 885-R, Belmont, Calif.**

AUTOMATIC
Sewage Regulators

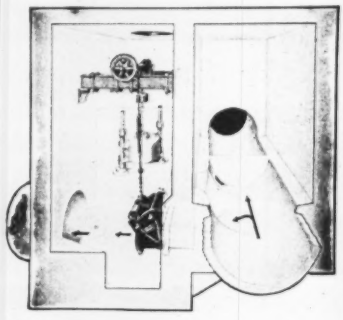

Fig. B-19

Automatic Sewage Regulators control sewage flows either by partially or completely cutting off such flows to suit head or tail water conditions or by "governing" to discharge a predetermined quantity regardless of head or tail water conditions.

Descriptive Bulletins and Engineering Data Available Upon Request

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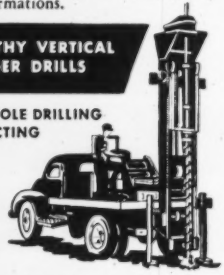

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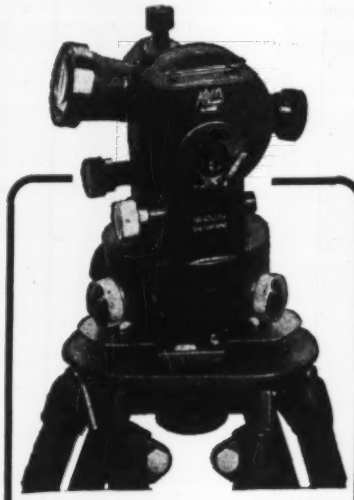

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Equipment, Materials & Methods (Continued)

Magnetic Sweeper

REALIZING THAT NAILS, spikes, tacks and other jagged iron pieces on roadways, factory floors and other areas cause millions of dollars' damage yearly in tire blowouts, falls, and other accidents, design engineers at the Eriez Manufacturing Company, Erie, Pa., have developed a highly versatile and efficient magnetic cleaner—the Super Sweeper. The Super Sweeper can be pushed by hand, pulled by a jeep, or suspended from an industrial lift truck to remove all tramp iron from highways, parking lots, factory aisles, airports and other areas. Because of the great variety of operating conditions encountered—speed, unevenness of surfaces cleaned, and types of tramp iron collected—the unit is easily adjusted to heights of 1 in., 1½ in., or 2 in. This is accomplished by mounting the wheels on strong steel shafts which are, in turn, welded to an adjustable eccentric shaft connected to the end of the magnetic element. By loosening two setscrews, the shaft can be rotated so that various road clearances are quickly obtained. One of the most valuable features of the unit is the beam-like construction of the magnetic element. The magnets are enclosed in a light, strong, square aluminum housing which is of sufficient size to permit manufacture of the sweeper in three strengths and in four widths: 24 in., 36 in., 48 in., and 60 in. By removing the wheels and handle, which are easily taken off for storage and transportation, and employing the sweeper's built-in eyebolts, the unit is quickly attached to an industrial lift truck. Another important feature is the method of cleaning the magnet of accumulated tramp iron. A heavy canvas-reinforced cover utilizes two built-in steel rods which are held in place by the magnet's power of attraction. It is an easy matter to turn the magnetic element to a face-up position, strip off the rubber cover, thus removing the metal from the magnet face. **Eriez Manufacturing Co., CE 12-115, Erie, Pa.**

Asphalt Mixer

THE HTD-500 Multi-Pug asphalt mixer, recently added to the company's line of portable asphalt mixers is especially suited to hot or cold patching in any season under wet or dry conditions. It is precisely engineered, rigidly constructed and thoroughly tested in handling on-the-job mixtures of asphaltic concrete, sheet asphalt, sand asphalt, or mastic asphalt at high production rates. The HTD-500 reactivates and heats stock pile mixtures up to 15 tons per hour. It prepares cold asphaltic mixtures up to 30 tons per hour and prepares hot asphaltic mixtures up to 10 tons per hour. It dries various types of wet aggregates quickly and thoroughly and removes both moisture and solvents from bituminous mixtures, and processes tars, paving asphalts, cut-back asphalts, and emulsified asphalt. **K. E. McConnaughay, CE 12-115, Lafayette, Ind.**

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Literature Available

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HIGHWAY EQUIPMENT—The latest methods and equipment used in the construction of concrete airports and highways outlined in a fully illustrated 20-page booklet. The booklet deals primarily with such equipment as automatic batchers and batching plants, new type heavy duty steel forms, fast portable finishing machines, automatic dual and tie bar installation, high speed joint installation, automatic membrane curing, subgrade planning and testing. Bulletin M-12. **The Heltzel Steel Form and Iron Company, CE 12-116, Warren, Ohio.**

DOORS—A completely informative booklet, for general distribution, devoted exclusively to Kinnear Rol-TOP Doors for commercial and industrial application has been published. While this particular Kinnear Door is in the upward acting, sectional type or overhead category, it does offer several distinctive construction features, perhaps the most important of which is the "Keystone" sealing device or design. **Mr. W. D. Pearson, General Sales Manager, The Kinnear Manufacturing Co., CE 12-116, Fields Ave., Columbus 16, Ohio.**

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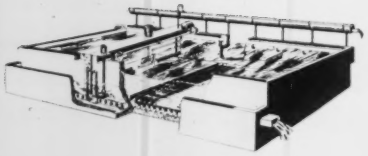

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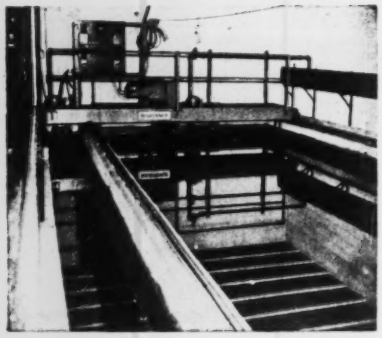

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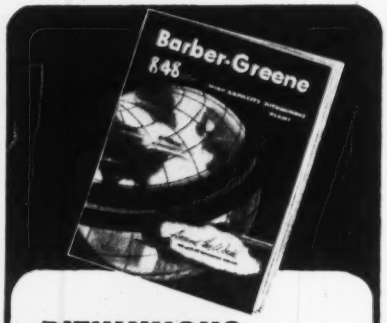

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DISTRIBUTOR—The availability of a 20-page, two-color bulletin, "The Dorreo Distributor" has been announced. It describes Distributor types, sizes and capacities, operating and mechanical features, and applications to both high and low rate trickling filter treatment. Also included are photographs of actual installations as well as cut-aways and wash drawings illustrating mechanical details. **The Dorr Company, Barry Place, CE 12-117, Stamford, Conn.**

CRUSHERS—A booklet giving information on how to go about making the most efficient and satisfactory application of various types of crushers to specific jobs has been published. All the important factors that go to influence operation, such as power consumption, parts wear, maintenance costs, uniformity of product and others are discussed in detail. Also, a check list is given that goes a long way to help determine the best type of crusher for various jobs. It will be sent free of charge to anyone sending in a request on a company letterhead. **Pennsylvania Crusher Company, CE 12-117, 1727 Liberty Trust Bldg., Philadelphia 7, Pa.**

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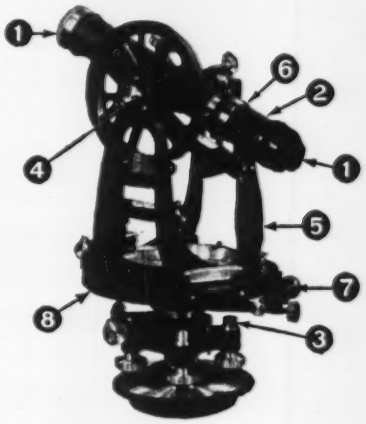

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August

230. **Total Sediment Load Measured in Turbulence Flume,** by P. C. Benedict, M. L. Albertson, and D. Q. Matejka. (HY)

231. **An Analysis of Water Quality Criteria,** by J. E. McKee and Vinton W. Bacon. (SA)

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248. **Advances in Sewage Treatment in the Period from October 1, 1951, to September 1, 1952:** Progress Report of the Committee of the Sanitary Engineering Division on Sewerage and Sewage Treatment. (SA)

249. **A Method for Calculating Stresses in Rigid Frame Corners,** by Harvey C. Olander. (ST)

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October

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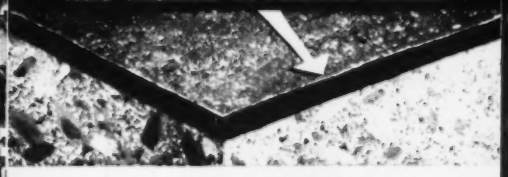

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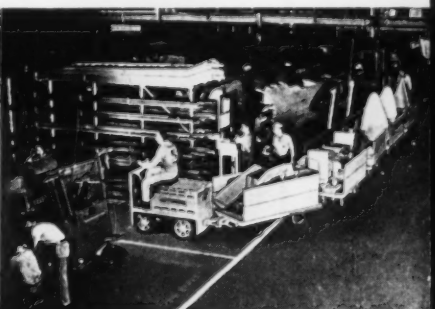

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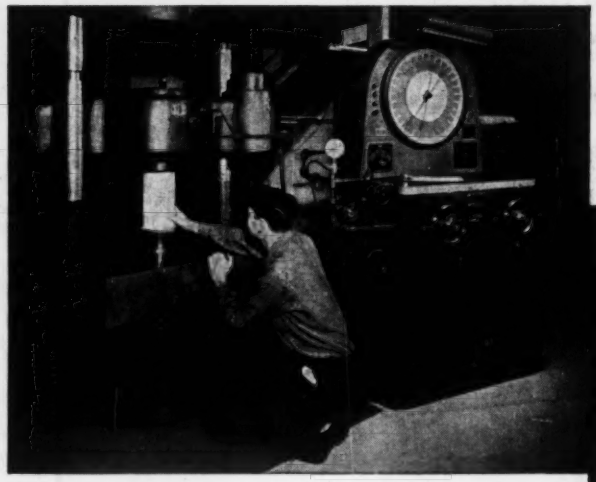

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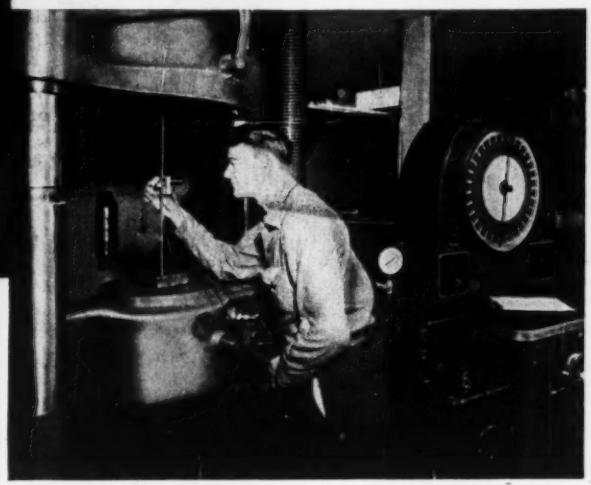

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